ISDN

A USER'S GUIDE TO SERVICES, APPLICATIONS & RESOURCES IN CALIFORNIA

A PACIFIC TELESIS COMPANY / PACIFIC BELL®

ISDN

A USER'S GUIDE TO SERVICES, APPLICATIONS & RESOURCES IN CALIFORNIA

PUBLISHED BY
PACIFIC BELL

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Pacific Bell
Business Market Group
2600 Camino Ramon
San Ramon, CA 94583
Telephone: 510-823-7543
Facsimile: 510-277-1808

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Preface

A LETTER FROM PHIL QUIGLEY

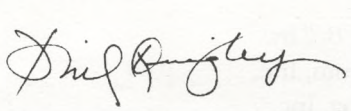
We at Pacific Bell are pleased to publish this guide to ISDN – how it works, what it does and can do, and how our customers throughout California have begun to put it to work.

ISDN is without a doubt one of today's most important communications technologies. It offers inexpensive and virtually unlimited access to the world's growing digital network, not only to large and small businesses, but to scientists and professionals, students and teachers, government organizations and consumers in general.

It also gives us a tool to start solving some of our most pressing problems – from making our air cleaner and our highways less congested, to offering better, more affordable health care, to expanding the reach of expert teachers into distant schools and even our homes.

This document would not be possible without the dedication of Pacific Bell people, and I thank them for their efforts. We also owe a great debt of gratitude to our customers, so many of whom gave freely of their time and energies to share with us their ideas, applications and insights.

We hope this booklet will be useful to you, and that as you begin using ISDN to achieve your own business and personal goals, you will continue to think of Pacific Bell as a helpful, responsive partner.



Phil Quigley
Chairman and Chief Executive Officer
Pacific Telesis Group

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ISDN: An Introduction 1

Integrated Services Digital Network – ISDN – is here, today, in California. In a Bay Area publisher's office and a Los Angeles bank, in a giant research lab and a small artist's studio, it functions as intended – and has begun to bring increased capabilities, reduced costs, and improved productivity to organizations both large and small.

In California today, ISDN delivers new capabilities, increased productivity and major cost reductions.

It offers dramatic increases in the speeds of data and document transfer. But that's just the beginning. Because it empowers a whole new breed of applications that this speed now makes possible – telecommuting, inexpensive video conferencing, teleradiology and remote health care, teleteaching, remote broadcasting and sound transfer, collaborative CAD/CAM engineering, LAN-to-LAN connectivity, interactive publishing and many, many more.

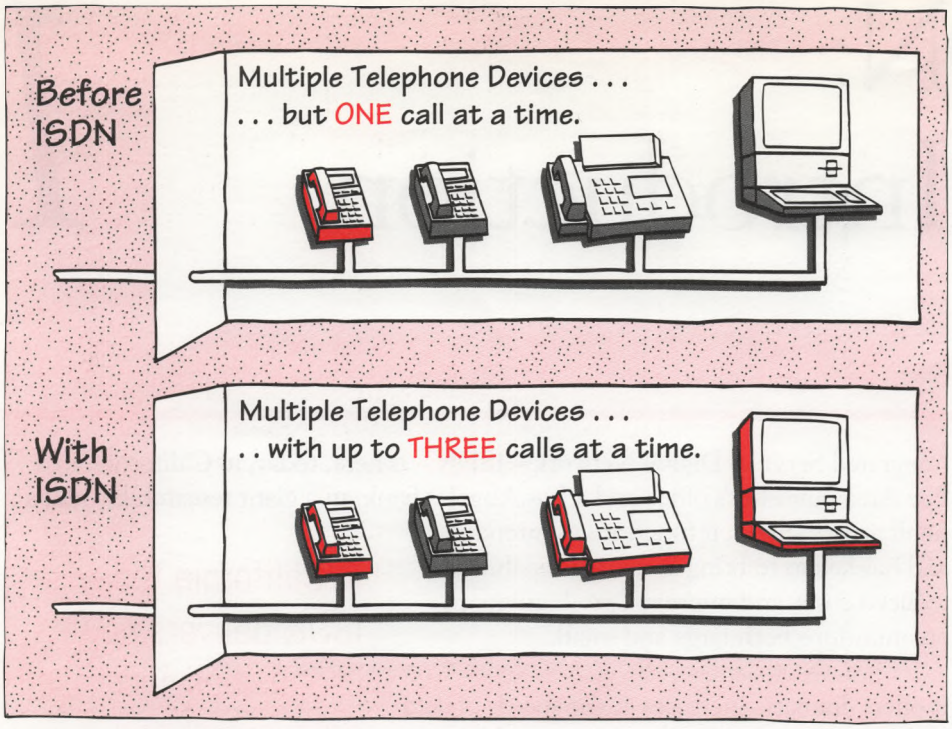
And improvements are being made every day – to the ISDN services offered by Pacific Bell, to the equipment produced by the world's leading manufacturers, to the statewide and worldwide telecommunications network that dynamically responds to the way the world does business.

Why Is ISDN So Important?

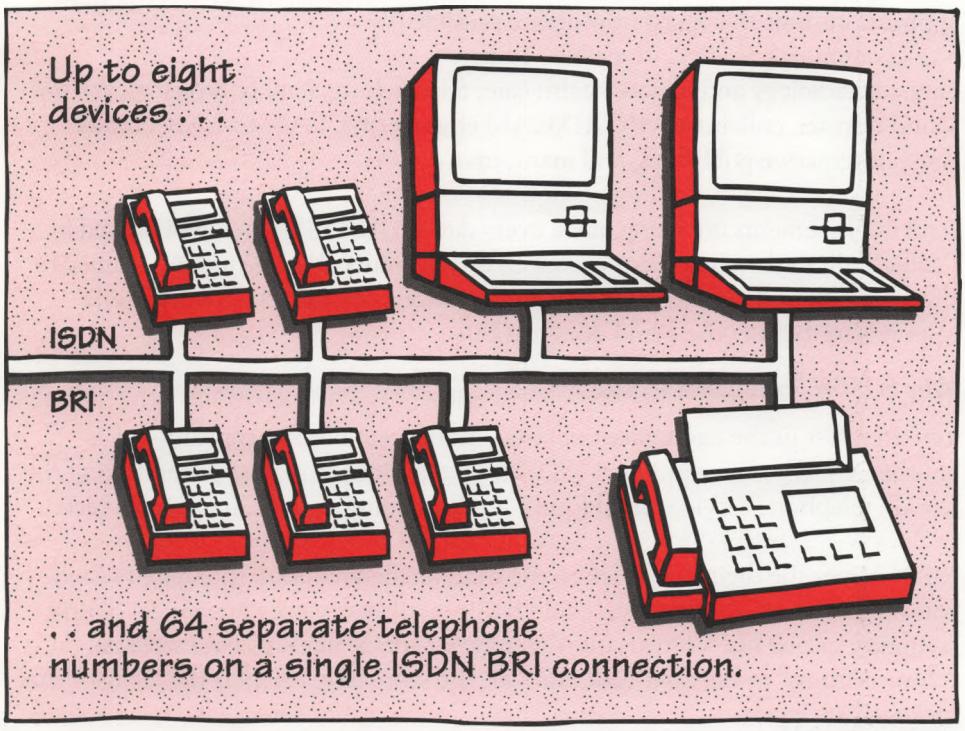
Yet often lost in the excitement of faster, more accurate data transmission is another, equally important fact. ISDN truly represents the next generation of the world's telephone service for all forms of telecommunications, including voice.

ISDN brings the digital network to the individual user. Thus, the same twisted-pair copper telephone line that could traditionally carry only one voice, or one computer or one fax "conversation" can now carry as many as *three separate* "conversations" at the *same time*, through the same line. ISDN is the "magic" that makes this happen.

How is this possible? The basic ISDN-to-user connection, called a *Basic Rate Interface*, or BRI, contains three separate channels, or "pipes." Two of these channels (the B channels) carry user "conversations" from a telephone, a computer, a fax or almost any other device. The third channel (the D channel) carries call set-up information for the network, but can also carry user data transmissions.


Before ISDN
Multiple Telephone Devices . . .
. . . but ONE call at a time.
With ISDN
Multiple Telephone Devices . . .
. . with up to THREE calls at a time.

Three conversations at a time. *The digital connection of ISDN delivers three separate communications channels, letting users carry on two separate voice and/or data calls at the same time, through the same line, with a third packet-switched data call on the D channel.*



Multiple devices and multiple numbers. *Depending on the capabilities of the central office switch, ISDN can support up to eight devices and as many as 64 separate telephone numbers through a single BRI connection.*

That means that two separate "conversations" – say, a voice call and a computer transmission – can take place at the same time through the same ISDN line. Simultaneously, a third "conversation" – a CompuServe session or a credit-card authorization, as examples – could also take place through the same connection. The power of ISDN enables *all three* of these transmissions to happen at the same time, through the same copper twisted-pair telephone line that once could handle only one transmission at a time.

It is no longer necessary to have multiple telephone lines to handle multiple telephone devices, or multiple telephone numbers, or multiple telephone calls. One ISDN line does it all.

But there's more. Because as many as *eight separate devices* (telephones, computers, fax machines, and more) can be connected to the same ISDN line – and each given as many separate telephone numbers as needed. All of which means it is no longer necessary to have multiple telephone lines to handle multiple telephone devices, or multiple telephone numbers, or multiple telephone calls. One ISDN line does it all.

ISDN telephones can, of course, call to and receive calls from ordinary telephones everywhere, since the digital and analog systems are fully interconnected. Digital ISDN connections also produce voice conversations that are absolutely quiet and crystal-clear, every time.

What's Required for ISDN?

Amazingly, most of the telephone wiring in place today – the copper twisted pairs that have carried telephone conversations since the days of "number, please?" – can successfully transmit ISDN digital signals. Although some older buildings and homes may need to upgrade wiring, most are "ISDN ready" today.

The other requirement for ISDN is access to a suitably equipped digital switching system. Today, the availability of these switches is growing rapidly. By the end of 1994, Pacific Bell schedules indicate that a vast majority of businesses and residences in most of California will be able to access the power, speed and amazing flexibility of ISDN.

A COMMITMENT TO CALIFORNIA

ISDN is becoming not just possible, but increasingly valuable, through the investments Pacific Bell and hundreds of other corporations are making to effectively rebuild the world's telecommunications infrastructure. With amazing speed, in fact, a new global digital network is being put in place to support the burgeoning information technologies of today and tomorrow.

Statewide Digital Switching

In 1993, for example, Pacific Bell announced a $1-billion plan to deploy the latest digital switching technology throughout California. The result will be a statewide communications system that is, in the words of Phil Quigley, Chairman and Chief Executive Officer of Pacific Telesis, "second to none." In this project, scheduled for broad implementation by 1997, the company will replace its remaining analog switches with AT&T 5ESS and Northern Telecom DMS-100 digital systems.

A Statewide Fiber Optic Network

Pacific Bell has also announced a $16-billion plan to expand the power and capacity of its digital network. Called *California First*, the program calls for new high-speed fiber optic information highways throughout the state, as well as the replacement of copper phone lines serving California's 10.4 million businesses and residences. By the year 2000, more than 6.5 million customers will be equipped either fiber optic or coaxial cables.

"Modern telecommunications is vital to the prosperity and the well-being of Californians. It is a critical part of an economic and social framework that determines the quality of everything from our industry to our schools to our air."

Phil Quigley, Chairman & CEO, Pacific Telesis Group

The purpose of this emerging digital network is twofold. In its own interest, Pacific Bell expects its investments to return significant yearly savings in maintenance, parts inventories, training and other operating expenses. More important in the long term, however, is the impact that digital communications will have on the economy and quality of life in California.

CalREN

To make sure that all of these advantages begin to take place quickly, Pacific Bell has also established *CalREN*, the California Research and Education Network, a financial-assistance trust to stimulate development and dissemination of practical, economically sound telecommunications applications.

CalREN programs focus on education and health care, business and governmental process, new business development and job creation, and the economic competitiveness of California. Based on potential merit, projects receive free access to high-speed communications services for a specified period of time.

CalREN Information

Information about CalREN-awarded projects is available electronically through the *Internet,* by accessing the Pacific Bell Gopher server, or by e-mail to calren@pacbell.com.

In addition, a quarterly newsletter of project highlights is planned. To subscribe, call 1-800-CalREN7.

Education First

Pacific Bell has also taken the lead in bringing digital communications to California public schools and libraries. In a $100-million program called *Education First*, four ISDN lines will be installed in each of California's 7,400 schools, libraries and community colleges by 1996. Installation charges will be waived, as will the first full year of Pacific Bell usage.

"The information superhighway is a path to California's future," said Governor Pete Wilson. "Only by bringing information technology into our classrooms and libraries will that path be open to our kids."

EXAMINING THE WORLD OF ISDN

This booklet has several purposes. The first is to explain ISDN in terms that are understandable to the interested user. The second is to examine the thousands of new applications and day-in, day-out advantages that ISDN brings to California and the world. The third is to offer practical help in putting ISDN to work.

Understanding ISDN

As a start, the next chapter – *ISDN Fundamentals* – takes a closer look at the basic technology of ISDN, how it works, and how it will begin to change and influence the lives of literally millions of Californians.

A Wealth of Applications

The succeeding chapters focus on some of the many uses of ISDN, and how it offers improved productivity, lower costs, and more efficient use of valuable human and equipment resources. Some of the applications include:

- *ISDN Closes the Digital Loop*. Chapter 3 explores the world of shared data, images, ideas and information – from telecommuting and worldwide workgroups, to linking remote LANs across a corporate campus.
- *ISDN Helps Database Systems Come of Age*. Chapter 4 shows how ISDN makes finding information easier – from letting high-end research systems offer more useful images and menus, to bringing photographs, catalogs and other visual data on-line.
- *ISDN Produces Better, Less Costly Meetings*. Chapter 5 is an overview of how ISDN brings people together – from students in a class with a teacher 3,000 miles away, to executives attending a meeting without ever leaving their offices.
- *The Voice of Tomorrow*. Chapter 6 looks at how ISDN brings better, less expensive voice telephone service to virtually any installation.

Installation, Information and Help

Finally, Chapter 7 – *Putting ISDN To Work* – looks at some practical matters: the various configurations of ISDN in the market, individual Pacific Bell services, the range of equipment available today, how to get started, who to call, and how to get more information and help. The appendices include a listing of major equipment manufacturers, and a guide to resources, books and other support.

A Technology of Today

ISDN has been called a "technology of the future." But it is also a vital thrust of today, answering the needs of today, and amazing even its most avid supporters with the speed and enthusiasm of its acceptance, installation and use. As the world's telecommunications network becomes increasingly digital, ISDN is the final link extending this digital system to the desktops of individual users.

Advantages of a Digital Network

Why is a digital network important? There are two basic reasons: clarity and speed.

First, digital signals ignore the static and noise that often affect analog transmissions, especially over long distances and older telephone lines, producing connections of the highest possible quality. They offer quiet, static-free voice conversations, and virtually error-free data connections, worldwide.

Second, they carry data at significantly higher speeds, and promise even greater speeds as digital compression and other techniques become more sophisticated and available.

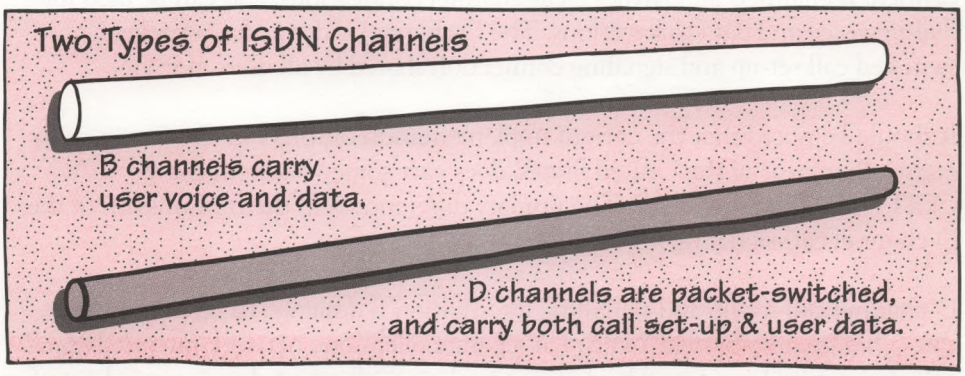
ISDN Fundamentals 2

Integrated Services Digital Network is a set of digital transmission protocols defined by CCITT (the Consultative Committee for International Telephone and Telegraph, which was recently renamed the Telecommunications Standards Bureau of its parent, the International Telecommunications Union). The protocols are accepted by virtually all the world's communications carriers as standard.

Some of the characteristics that distinguish ISDN are:

✦ ***It builds on groups of standard transmission channels.*** Bearer channels (or B channels) transmit user information at relatively high speeds, while separate Data channels (or D channels) carry call set-up, signaling and other information.

Two types of ISDN channels. *B channels are clear-channel "pipes" for user voice and data. D channels are packet-switched links for call set up and user data.*

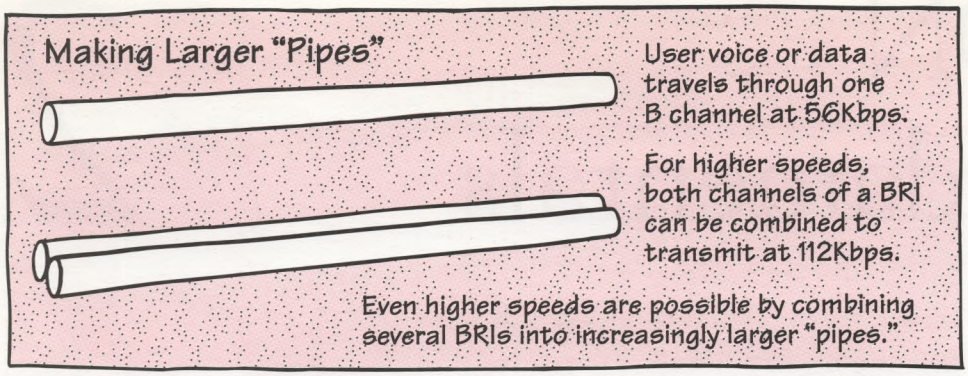

Two Types of ISDN Channels
B channels carry user voice and data.
D channels are packet-switched, and carry both call set-up & user data.

✦ ***It handles all types of information.*** Unlike some other digital communications technologies, ISDN handles all types of information – voice, data, studio-quality sound, still and moving images. They are all digitized, and transmitted at high speeds in the same flow of data.

✦ ***It handles many devices and many telephone numbers, on the same line.*** Up to eight separate telephones, fax machines or computers can be linked to a single ISDN connection, and have up to 64 "call appearances" of the same or different telephone numbers.

✦ ***It supports up to three calls at the same time.*** Two voice, fax or PC "conversations," and one data "conversation" can take place at the same time, through the same ISDN connection.

✦ ***It offers variable, responsive transmission speeds.*** Two or more channels can be combined into a single larger transmission "pipe." Channels can be assembled as needed for a specific application (a large video conference, for example), and then broken down and reassembled into different groups for different applications (normal voice or data transmissions). Combining B channels in this manner is called inverse multiplexing, or bonding (*see diagram on next page*).


Making Larger "Pipes"
User voice or data travels through one B channel at 56Kbps.
For higher speeds, both channels of a BRI can be combined to transmit at 112Kbps.
Even higher speeds are possible by combining several BRIs into increasingly larger "pipes."

Combining channels to make larger "pipes." *Called inverse multiplexing, or "bonding."*

✦ ***It uses switched digital connections.*** Perhaps the most important single feature of ISDN, however, is that it offers inexpensive *dialed* digital access to the worldwide telecommunications network. It is no longer necessary to lease costly dedicated lines for high-speed digital transmission, or to limit data speed and accuracy by using modems to convert digital signals to analog pulses.

ISDN BASICS

ISDN is delivered from a digital switch through two types of user interfaces: the *Basic Rate Interface* (BRI) and the *Primary Rate Interface* (PRI). Each consists of a number of 64Kbps bearer, or B channels, coupled to one data, or D channel. As defined, B channels are 64Kbps clear-channel connections, and can be used for dial-up voice and data connections. The D channel is defined as a packet-switched call set-up and signaling connection shared by all users of ISDN.

It should be noted that the current implementation of ISDN in California, as in many other areas of the United States, does vary somewhat from these CCITT/ITU-TSS standards. The primary difference is in the transmission of the D-channel call-signaling information.

D-channel call set-up and signalling information is designed to be transmitted through Signaling System 7 (SS7), a separate telephone network intended specifically for statewide and worldwide call-signaling. Call set-up data is carried *out-of-band* rather than *in-band* as it is today in California.

SS7 is functional today in most of California. Once deployed statewide and fully connected, or *interworked*, to all areas of ISDN, Pacific Bell ISDN will match international recommendations with an *out-of-band* D-channel network. The result: B-channel bandwidth will be increased from 56Kbps to a full 64Kbps.

Transmission Speeds

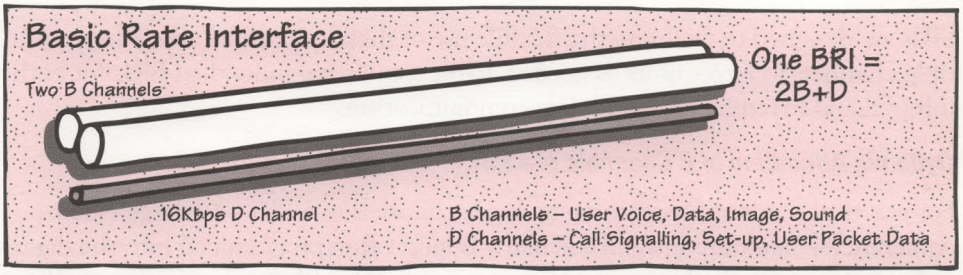
Transmission speeds are most often measured in *bits per second*, or bps. Commonly used abbreviations are:

Kbps	**Kilobits per second**	**Thousand bits per second**
Mbps	**Megabits per second**	**Million bits per second**
Gbps	**Gigabits per second**	**Billion bits per second**

The term bit is a contraction of *bi*nary digi*t*, the smallest unit of digital information – either an on or off signal. The major computer codes use either seven (ASCII) or eight (EBCDIC) bits to represent one letter, number or symbol.

Basic Rate Interface

The Basic Rate Interface – or BRI – is defined as two 64Kbps Bearer (B) channels, and one 16Kbps Data (D) channel that carries both call set-up and user packet data across the network. The BRI interface is also referred to as a 2B+D connection.


Basic Rate Interface
Two B Channels
One BRI = 2B+D
16Kbps D Channel
B Channels – User Voice, Data, Image, Sound
D Channels – Call Signalling, Set-up, User Packet Data

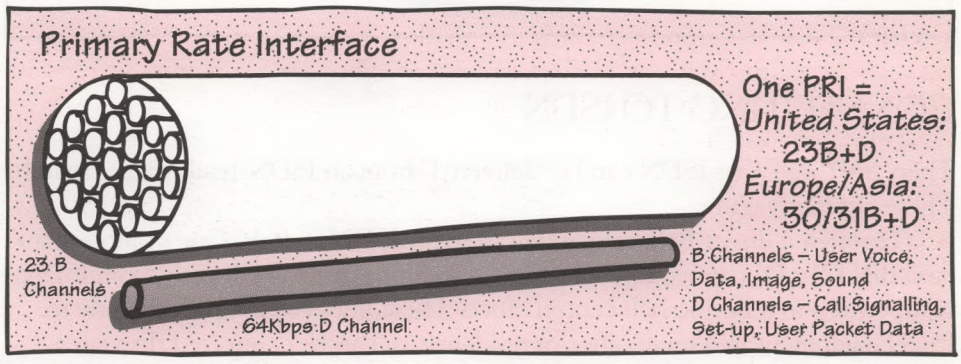
The Basic Rate Interface. *A BRI delivers three separate channels.*

As noted earlier, BRIs can carry a wide and flexible range of communications. A single BRI, for example, can carry two simultaneous voice or data conversations (to the same or different locations). In either example, the D channel can also be used for packet communications to a third location, also simultaneously. The two B channels can also be combined for transmitting data at uncompressed speeds of up to 112Kbps currently, and 128Kbps uncompressed in the future.

In addition, a wide range of devices and telephone numbers can be associated with a single BRI. As highlighted in greater detail throughout this book, and especially in Chapter 6, this capability alone offers incredible equipment flexibility, and major reductions in line, wiring and installation costs.

Primary Rate Interface

The Primary Rate Interface – or PRI – in the United States consists of 23 64Kbps Bearer (B) channels and one 64Kbps Data (D) channel, or a 23B+D connection. With a total bandwidth of 1.544Mbps, it is designed for transmission through a standard North American T-1 trunk.



The Primary Rate Interface. *A PRI contains 23 B channels, plus one D channel.*

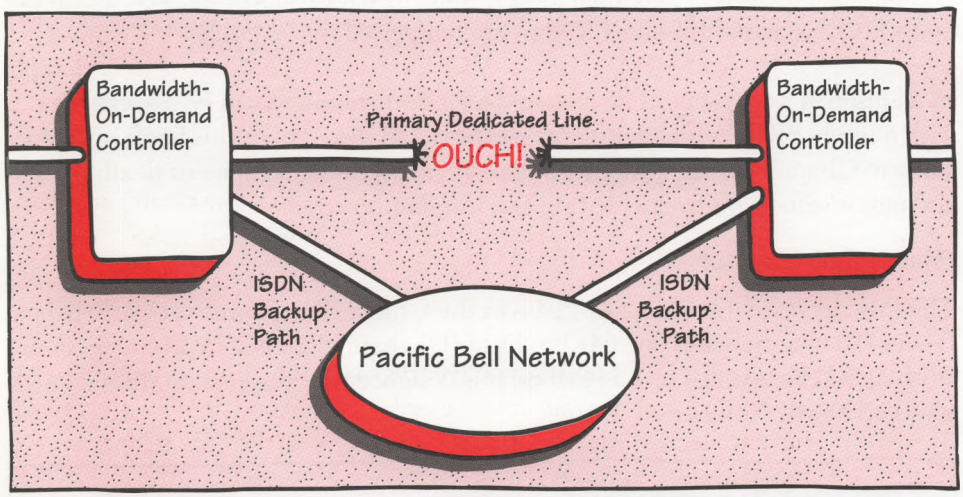
In Europe and the Pacific Rim, because transmission standards differ slightly, the Primary Rate Interface is supplied through a standard 2.048Mbps E-1 channel, and consists of either thirty or thirty-one 64Kbps B channels, and one 64Kbps D channel – thus 30B+D or 31B+D. Although the specifics of ISDN implementation are still slightly different from nation to nation, interconnections between any two systems in the world are now not only possible, but increasingly practical.

PRIs are dedicated trunks that connect medium and large locations to a telephone company central office. Virtually all modern telephone and computing systems can be connected to ISDN through a PRI – including PBXs, mainframe and distributed systems, LANs and WANs, multiplexers and ISDN controllers, video conferencing units, and more.

PRIs are designed to facilitate the flexible use of these systems by allocating multiple channels to larger units as needed, while supporting individual BRIs for both internal and external voice and data communications.

Dynamic Allocation of B Channels in a PRI

For practical purposes, combining multiple channels in a PRI – for large video conferences, data transfers and the like – is most often programmed into the digital switch serving the location. However, new bandwidth-on-demand controllers have begun to enable a network manager to combine larger bandwidths in real time to meet specific needs. They can also monitor quality and traffic on both corporate leased-line and ISDN networks, and perform dynamic allocation of B-channels to relieve bottlenecks, or back-up error-prone or damaged lines.



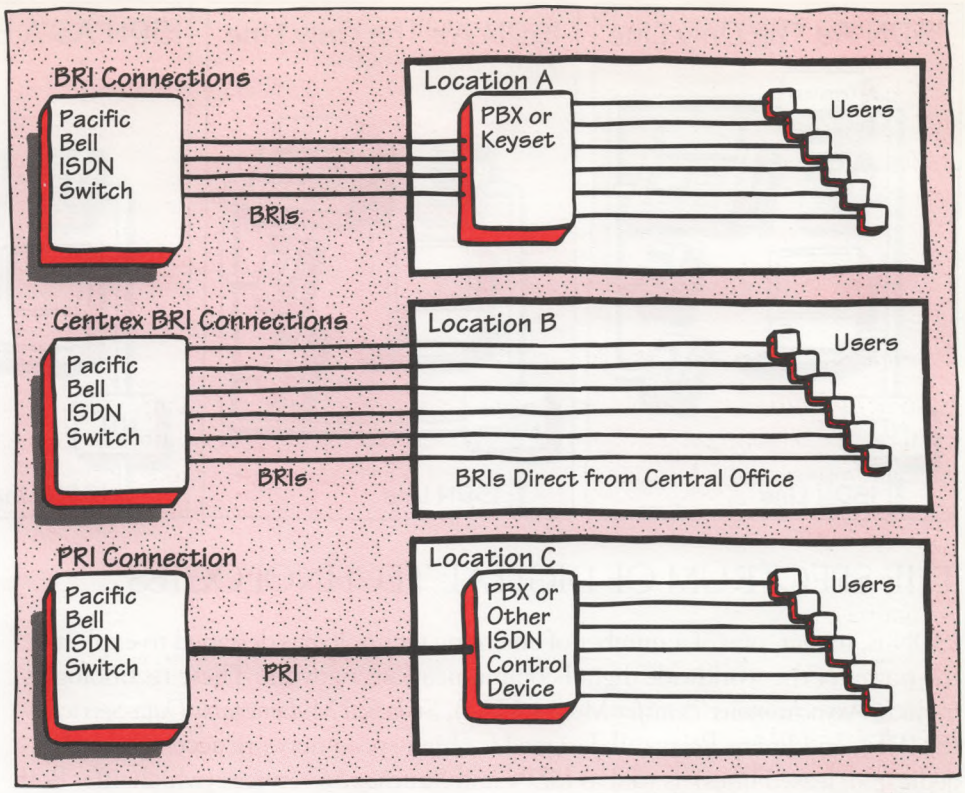
Dialed backup. *ISDN channels are dialed only as needed for overflow or out-of-service conditions.*

CONNECTING TO ISDN

There are three ways ISDN can be "delivered" from an ISDN-ready digital switch. These alternatives are:

- ***Through a direct BRI connection from an ISDN switch.*** One or more standard BRI (2B+D) connections can be used to link a company directly to an ISDN-ready switch in a Pacific Bell central office. These lines can connect directly to ISDN equipment in a small office or residence, or can be connected through a PBX or key system so that devices can communicate with one another without having to call through an outside connection (*Location A in the following chart*).
- ***Through ISDN Centrex service.*** One or more BRIs can also be linked to ISDN Centrex service (*Location B in the chart*). This arrangement offers several advantages for an individual or company. Since the ISDN switch functions as their switching system, the company does not have to own or maintain a PBX or key system. It also offers a low-cost, virtually unlimited growth path.
- ***Through a PRI connection.*** A PRI delivers 23 B channels plus one D channel from the telephone company to a PBX or other control device, which then distributes the B channels as needed throughout an organization (*Location C*). How

Delivering ISDN from a Pacific Bell digital switch.



this configuration is set up can vary greatly. Users with heavy data traffic, for example, might configure the connection through an ISDN router, multiplexer or controller, rather than a PBX – reducing the chance of congestion through the switch.

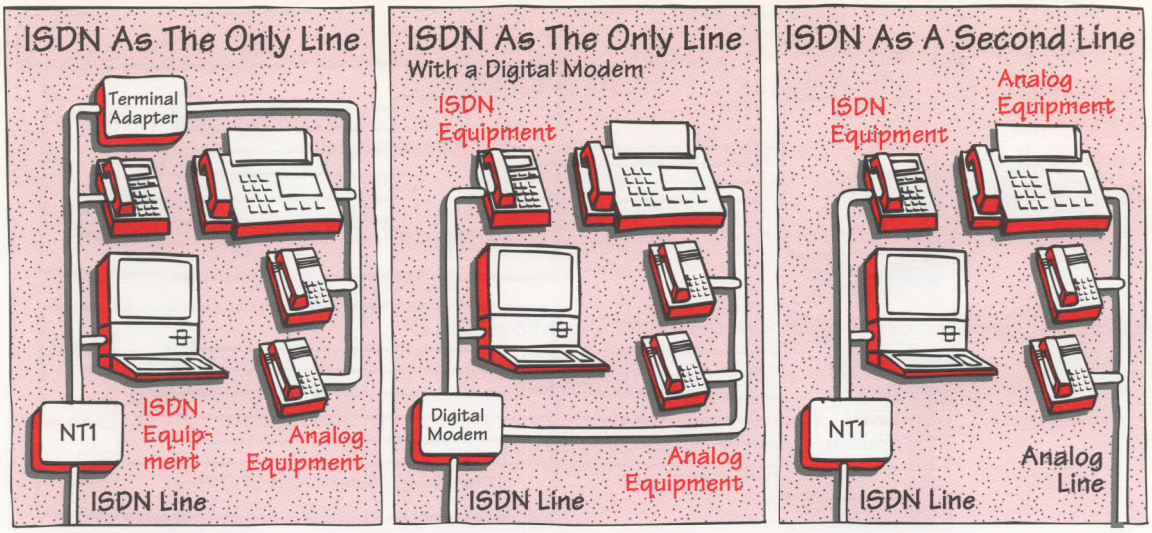
ISDN as the Only Line, or as a Second Line

While ISDN is specifically designed to deliver digital connections through existing copper twisted-pair lines, many smaller locations (and many larger ones as well) will have to decide whether or not to use ISDN as the only telephone connection, or to install it as a separate, second line.

Depending on existing equipment and usage, an office or home might configure ISDN in several ways (*see diagram on the following page*):

- ***ISDN as the only line.*** This requires that all telephones and fax machines be ISDN systems, or be linked through a special terminal adapter, and that all PCs or other computers have special ISDN cards installed.
- ***ISDN as the only line, using a "digital modem."*** By adding a specialized device – such as an IBM *WaveRunner* digital modem – to the line, both ISDN equipment and existing telephones or faxes can share a single ISDN line. A digital modem can cost less than a single fully equipped ISDN telephone.
- ***ISDN as a second line.*** This alternative, often the least expensive, lets ISDN bring higher data speeds and other advantages to ISDN equipment, while existing analog lines serve existing analog phones and faxes. The drawback: it is not possible to "roll over" calls from ISDN to the analog lines, or vice versa.

Depending on needs and expectations, these alternatives let users migrate to ISDN in one sweeping move, or in measured steps – replacing older equipment in a systematic, economical way.



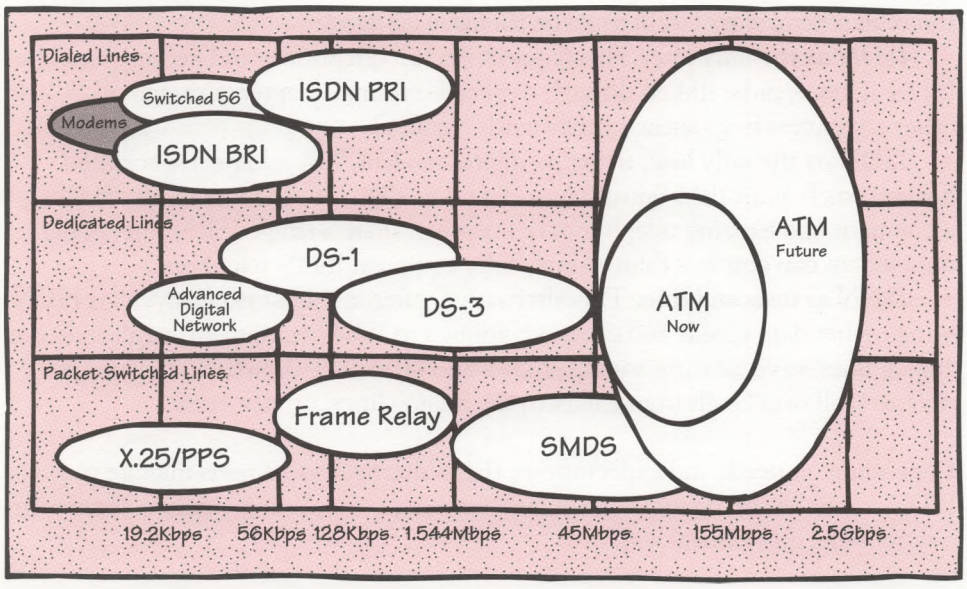
THE SPECTRUM OF DIGITAL TECHNOLOGIES

Alternate wiring plans. *A decision based on user needs and existing equipment.*

ISDN is, in fact, one of a number of emerging technologies designed to exploit the power of the worldwide digital communications network. These technologies include *Asynchronous Transfer Mode* (ATM), *Switched Multimegabit Data Service* (SMDS), and *Frame Relay* (all designed for high-speed network access through dedicated, leased lines) as well as *ISDN* and *Switched 56* services (which offer both dedicated and dialed access).

The Unique Value of ISDN

To many users, especially individuals and those in smaller companies, ISDN is by far the most important of these technologies. To literally millions of users, it offers inexpensive dialed service, high-speed data transmission, and the ability to send and receive voice, data, still and moving images through the same fully digital connections. It is also a communications standard accepted throughout the world, which means that voice and high-speed data connections to most of the major business centers of Europe and the Pacific Rim are literally no more than a simple, dialed phone call away.



The growth of digital technologies. *A logarithmic chart showing the technologies, and the acceleration of transmission speeds made possible by the worldwide digital network.*

ISDN Closes the Digital Loop 3

The real promise of ISDN, as noted earlier, is in replacing the dialed analog connections of the past with the dialed digital connections of the future. The ramifications for those who use computers are many.

- ***Digital-to-analog conversions will go away.*** Modems to convert the digital signals of PCs, computers, LANs, and other devices to the analog signals needed for an analog network will be replaced. Instead, high-speed pulses will flow directly from one digital device to another through a totally digital network.

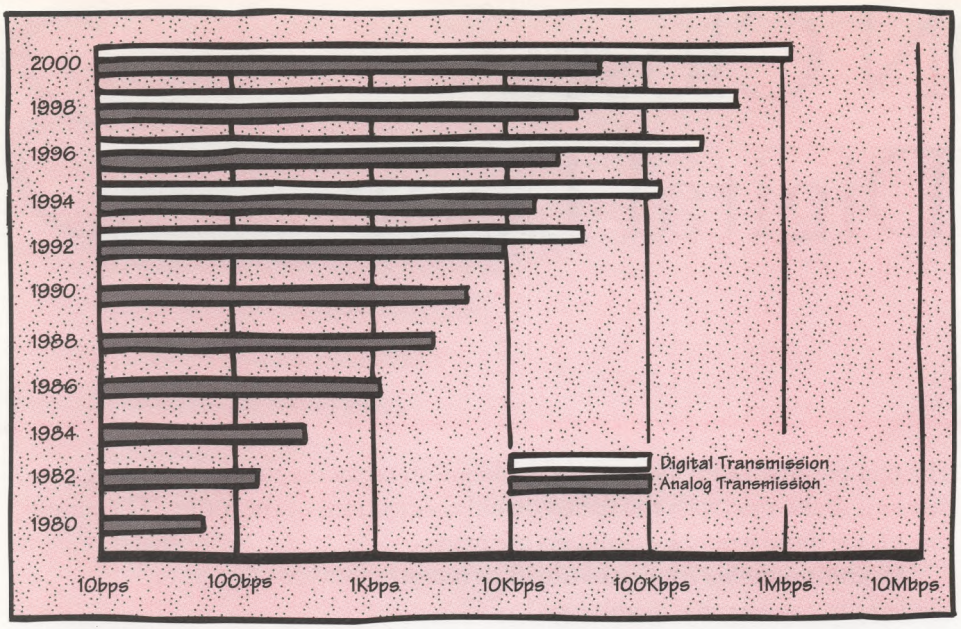
From the analog connections of the past to the digital connections of today.

- ***Many digital connections will become dialed, not dedicated.*** It will no longer be necessary to lease expensive dedicated digital lines simply to link a high-speed data device to the network. The deciding factor will be the economics of how fast the line must be and how frequently it is used.
- ***Endless connectivity possibilities will open.*** It will become possible to link individuals, networks, and systems that it is neither economical nor practical to link today.

Some obvious examples of these new applications are telecommuting, LAN-to-LAN or LAN-to-host interconnection, remote image sharing and retrieval, inexpensive teleconferencing, combined voice and document or image collaborations, high-speed access to remote files or databases, accelerated links to remote libraries and research systems, and literally hundreds of other applications.

While most of these applications are technically *possible* today without ISDN, very few are *practical* – either costs are too high or transmission speeds too slow.

The purpose of this ISDN guide, in fact, is to look at these innovative uses. Many are important breakthroughs; others merely helpful conveniences. But all in concert show beyond a doubt that an important new technology has begun to take its place on the stage of telecommunications throughout California and the world.



The increase of user's data speeds. *A logarithmic view of how transmission speeds available to individual users have accelerated in the past two decades. Digital speeds should continue to grow, while analog speeds begin to peak.*

WORK GROUP CONNECTIVITY

Today, both large and small organizations are choosing ISDN to bring people, offices and locations together in effective, easy-to-use communications systems.

ISDN, with its end-to-end digital connections, offers giant steps forward in speed – up to 112Kbps today – with the quantum leaps of digital data compression still to come. But that, in fact, is just the beginning. As more and more ultra-high-speed channels begin to bind the Pacific Bell network together, and the broadband cables that will carry high-definition television begin to reach into more and more areas, the growth of dialed digital transmission speeds available to ISDN users should continue unchecked well into the future.

PC Video Conferencing

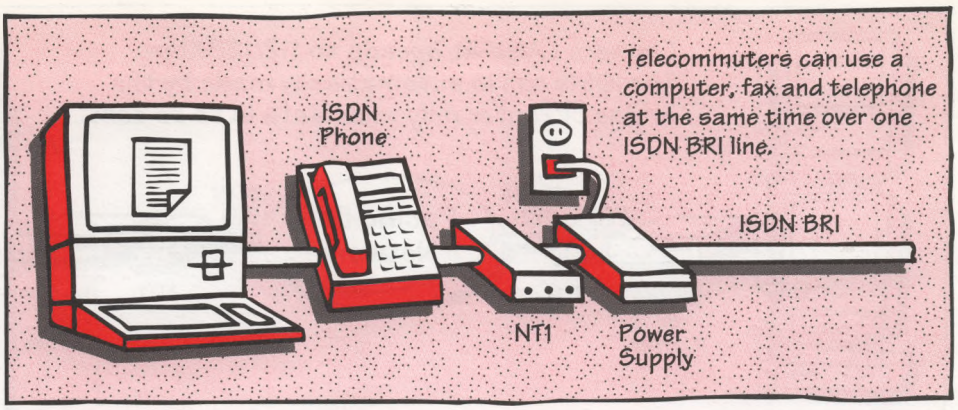
A number of manufacturers offer personal computer-based video systems that feature head-and-shoulders images of co-workers in windows on a standard high-resolution monitor. A camera and microphone atop each monitor provide acceptably clear photographs and sounds – all transmitted and received through a single ISDN BRI.

The result is an easily set up yet effective "virtual meeting" linking people in other offices, buildings or locations – making it ideal for telecommuting and other remote-access situations.

Refresh rates for the video images vary depending on the number of meeting participants, and the number of images a user chooses to display. In most cases, the result is full-motion, full-color television.

Telecommuting

Across the nation, legislative mandates are being put in place to reduce the number of cars commuting to and from an office each day. For example, the California Clean Air Act, effective in 1994, affects all large and mid-size companies, and allows only 74 cars in a company parking lot for every 100 employees. One immediate answer to this problem is telecommuting.


Telecommuters can use a computer, fax and telephone at the same time over one ISDN BRI line.
ISDN Phone
ISDN BRI
NT1
Power Supply

A basic ISDN setup for home or office. *The ISDN line does not provide its own power. Thus, an independent power supply is always required.*

The idea of ISDN telecommuting is simple: to "transport" as much of the functionality of the office as possible to a remote site through a single ISDN BRI connection. This functionality includes:

- Acceptably high-speed access to the user's LAN and file servers.
- Full access to mailboxes, and the ability to send, receive, forward and annotate both voice and written messages.
- Reasonably fast interconnections to other company LANs or hosts, remote systems, and other networks such as the *Internet*.
- Teleconferenced meetings, or the full-color images of co-workers through a range of rapidly emerging PC video technologies.

Note that often these dialed connections can be quite brief, which means that many at-home workers can share the same ISDN channels installed at a network or host, keeping up-front costs reasonable.

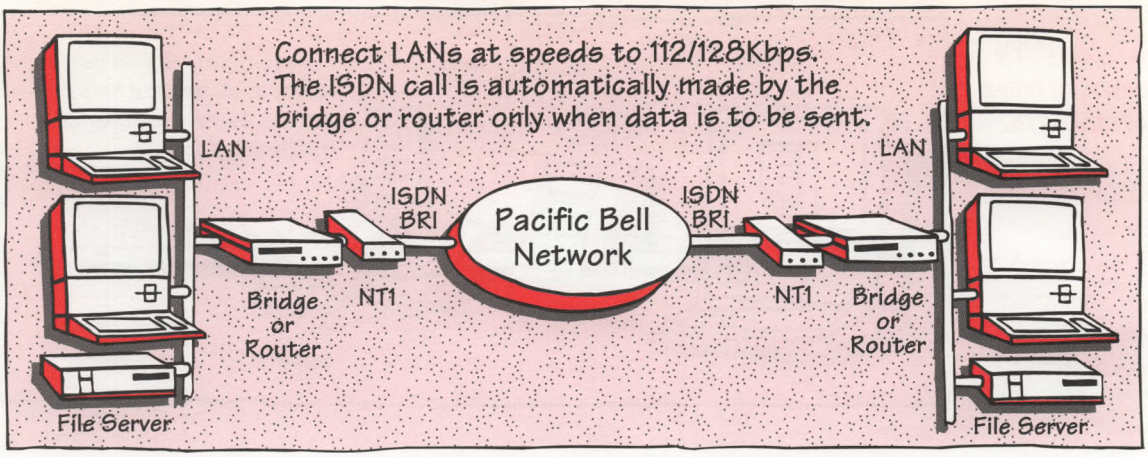
Efficient LAN or host access can also be important to someone who is traveling, or home ill, or spending the day at another location. With ISDN, they have not only better telephone contact with co-workers and messaging systems, but efficient laptop access to their LAN or file server.

Bob Metcalfe Telecommutes

One enthusiastic user of ISDN in California is Bob Metcalfe, the inventor of *Ethernet*, and now Publisher/CEO of the newsweekly *InfoWorld*. He uses an ISDN BRI to link an Apple PowerBook Duo in his home to the company's headquarters in San Mateo.

"My *NetWare* servers, LaserWriters, electronic mail, *Lotus Notes*, and *Internet* services are all right there," he notes, through a 2B+D connection. "ISDN is fast enough to extend LANs remotely so you can use them for telecommuting. For example, I'm not using *Remote cc:Mail* from home, but *cc:Mail* itself." For file transfers, his effective speeds through AppleTalk are about 90Kbps, which he calls "brisk for most of what I do."

In the near future, he expects speeds of up to 500Kbps through the same connection, because of evolving digital data compression techniques. "But even the 90Kbps I get now," he adds, "is an almost five-fold improvement over the analog modem connections which were bogging me down."



A typical LAN-to-LAN configuration. *The connection is used, and charges incurred, only when data is sent.*

LAN-to-LAN Links

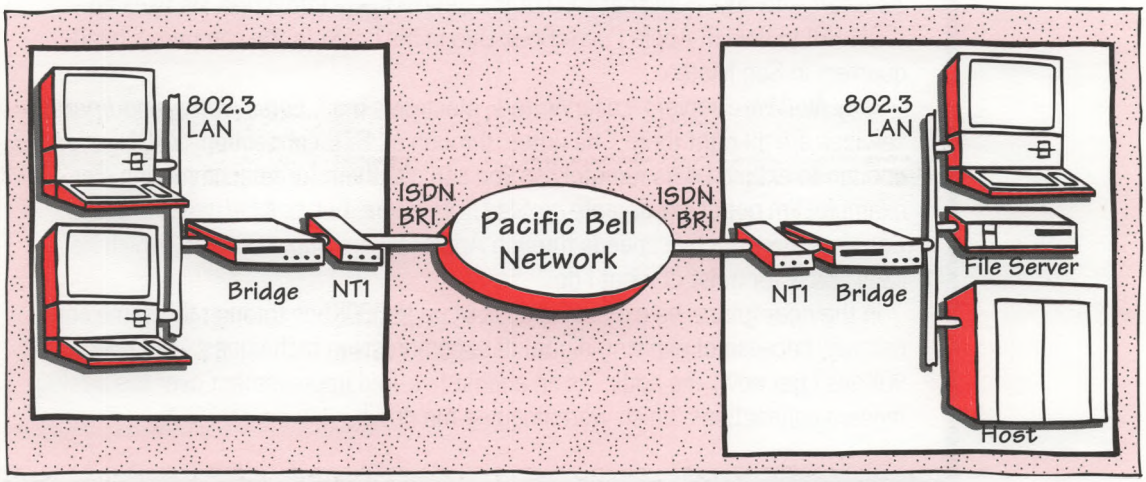
One of the most immediately accepted and widely used applications of ISDN is in linking LANs to each other and the outside world.

Information in most local area networks travels through dedicated fiber optic or coaxial cables at speeds of from 10 to 30Mbps. Which means that, contrary to a common misconception, ISDN was not designed to replace these LANs, or bridge them into larger local or wide area networks.

Rather, it *is* ideal for the cost-effective, *temporary* linking of LANs – to each other, to remote hosts, or to individual non-LAN users or locations – for the timely transfer of specific information or files. In fact, the growing popularity of these applications has spurred manufacturers to offer comprehensive lines of ISDN LAN-bridging and file-transfer equipment.

Are data rates fast enough? The answer today is a solid yes. Current data transfer rates are typically characterized by users as *acceptable* – a rating that should improve quickly as B-channel speeds increase in the near future. Higher LAN-to-LAN speeds are also possible now by inverse multiplexing multiple B channels into larger bandwidth connections.

A typical LAN-to-host arrangement. *Dialed connections offer enormous savings compared to dedicated links.*



Fast, Efficient File Transfers

Most transfers of large files today take place through dedicated broadband digital connections, or on magnetic media physically transported by messengers and overnight couriers.

The flexibility of ISDN PRI connections, in contrast, expands a system manager's options. It enables the same dialed B channels used for individual connections during the day to be combined into higher-speed links for after-hours file transfers to and from multiple points.

Similarly, many remote sites that currently have only analog access now content themselves with weekly revisions of pricing and inventory updates, manufacturing schedules and the like. The time required to transfer these files from a central system to multiple satellite locations through analog connections simply takes too long to make more frequent transmissions practical.

Similar limitations exist in many industries. Equity pricing services, for example, often use disks and tapes, messengers and overnight couriers for weekly price updates to the thousands of trust departments, pension funds and other money managers they serve.

The speed and flexibility of ISDN has already begun to solve these problems – with a combination of programmed dialing, flexible channel sizes, and high-speed downloads.

Remote Telemetry and Security

ISDN connections can also let machines talk to each other. At a leading California biotechnology company, an ISDN system initially installed for LAN-to-LAN connectivity, telecommuting and other uses now links computers to a growing number of monitoring devices for room and liquid temperature control, fluid disbursement, animal feeding, and the like. For each, the system helps maintain virtually flawless control.

Several other companies are also using ISDN for physical security in warehouses, receiving docks and other similarly vulnerable sites. Both B and D channels can be used as inexpensive conduits for remote TV cameras, and to monitor locks, alarms, and strategically placed sound, movement, heat and other sensors.

International File Transfer Times and Costs

California to Japan, average rates, not including taxes.

Twenty Megabit file	*Time*	*Cost*
14.4Kbps modem	**23.1 minutes***	**$29.85**
ISDN at 90Kbps	**3.7 minutes**	**6.32**

** Presuming full 14.4Kbps transmission speed*

International Facsimile Cost Comparisons

Bay Area to Japan, typical rates, not including taxes.

	Two-Page Letter		*200-Page Document*	
	Time	*Cost*	*Time*	*Cost*
Group 3 Fax	**80 secs.**	**$5.14**	**133 mins., 20 secs.**	**$201.82**
Group 4 Fax	**16 secs.**	**3.65**	**26 mins., 40 secs.**	**42.39**

Group 4 Facsimile

Group 4 facsimile offers increased speed, reliability and quality for point-to-point image transmission. Using B-channel digital connections, they transmit even the most complex drawings, documents or images anywhere in the world in less than eight seconds – with laser-print quality identical to the original. Problems of transmitting over long distances through analog connections are eliminated.

ISDN CONNECTIONS AT WORK

Throughout California, as throughout the world, ISDN has begin to offer extended solutions for accessing, using and sharing computer-stored data.

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory is one of the largest research organizations in the world. It also has one of the largest and most comprehensive ISDN installations in the United States. This uniform, modern communications system uses existing copper telephone wires, and not only enhances and expands voice capabilities, but transmits data and images at high speeds throughout a multi-building campus.

An on-campus AT&T 5ESS ISDN switch – linked to the federal government's coast-to-coast information highway as well as the Pacific Bell public network – supports a range of ISDN applications, including LAN-to-LAN and LAN-to-host interconnections for the transfer of data, files and images, and the extension of LANs to remote buildings. ISDN channels are also used for video conferencing among scientists at many research sites, including Los Alamos, Brookhaven, and Jet Propulsion Laboratory – as well as locations in Germany, Switzerland, Italy and Japan.

"A shining example of how ISDN is changing the way we work is telecommuting," said Stan Kluz, telecommunications engineer at LLNL, and also president of the California ISDN User's Group. More than a hundred employees currently work at home on a regular basis, with hundreds more scheduled to expand the process in the near future. ISDN lets them access the laboratory's numerous hosts and LANs, as well as their own electronic mail. They can talk to peers, and simultaneously work on documents, spreadsheets and other files.

ISDN also offers electronic access from the outside to several projects the laboratory is developing with the business community. Scientists, engineers and others can dial in to an appropriate system to view and collaborate on work in progress.

"We also try to think beyond '*killer applications*,'" said Kluz. "Rather, we look for the hundreds of small improvements that can make our life more pleasant and our work more productive." A typical example is the facility's electronic directory used by 30-40 operators serving the Livermore campus. All operators simultaneously share 40 logical channels in a single B channel linked to the Ethernet LAN holding the directory. The B channel acts as a concentrator, and the directory screen is always visible to every operator.

"It is," noted Kluz, "an elegant, yet inexpensive solution to an age-old problem."

Jet Propulsion Laboratory

As NASA's lead center in unmanned space exploration, JPL uses more than 12,000 computers, including PCs, workstations, micro and minicomputers, mainframes and beyond. For the most part, these are organized into an array of scientific, engineering and office-automation LANs.

ISDN lets JPL efficiently and economically link these diverse systems as needs arise, distribute information, and provide rapid data and image transfer from one work group to another – while simultaneously expanding and modernizing the voice system used by some 8,000 employees.

"ISDN lets us do whatever it takes to get the job done."

Jim Jacobson, Jet Propulsion Laboratory

"We can now put a 128Kbps link anywhere we need it to bring people, places or systems together," said Jim Jacobson, Task Manager of JPL's Advanced Communications Lab. "ISDN lets us do whatever it takes to get the job done."

JPL also uses ISDN for telecommuting, and for both regular and desktop video conferencing to reduce the time, effort and cost of travel. They find, for example, that engineering and system-design collaborations involving video, sound and shared, interactive computer screens are not only easier to arrange, but often more productive than face-to-face meetings.

As the use of ISDN grows throughout industry, says Jacobson, ISDN will also help to support the facility's outreach programs, bringing the useful technologies of space to all levels of the nation's business and education.

Caltech

The California Institute of Technology uses a digital switch at the local Pacific Bell central office to bring the double advantages of ISDN and Centrex services to its extended campus. It gives them remote high-speed Ethernet access and video conferencing.

ISDN can also be readily extended to faculty members and others living off-campus. Dr. Paul Messina, for example, widely known director of the Caltech Concurrent Supercomputing Facilities and assistant vice president for scientific computing, uses an ISDN link from his home for interactive access to the university's Intel DELTA Touchstone, one of the world's most powerful supercomputers.

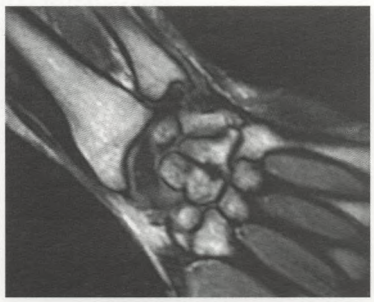
MEDICINE AND HEALTH CARE

As in so many other areas, the speed of ISDN takes applications that were "possible" before, and makes them practical and useful.

Medical Teleradiology

The range of images used in medicine includes Computerized Tomography (CT or CAT scans), Ultrasound, Nuclear Medicine, Magnetic Resonance Imaging, and of course the traditional X-ray. All except X-rays, in fact, originate as digital files which are most often viewed on a computer screen. Many X-rays in specialized applications, although they begin as films, are being scanned into a digital file.

The potential for transmitting these files, which are almost always large, is enormous – to specialized radiologists for analysis and diagnosis, to remote experts for consultation, to surgeons, to practiced technicians for image enhancement, to file with a patient's record, and more. And what was once tedious and impractical with a modem becomes fast and useful with ISDN.



Teleradiology. *Sophisticated medical images can now be quickly transported whenever and wherever they are needed, worldwide. MRI image courtesy of Toshiba America Medical Systems.*

ISDN also saves time when time is critical. A radiologist, for example, no longer needs to rush to a hospital in pre-dawn hours to look at an accident victim's CT scan. Rather, the image can be transmitted to a PC at the radiologist's home, where he or she can prepare a diagnosis while still in robe and slippers.

Hospitals and specialized radiology laboratories are today becoming libraries for these images, so that the speed of ISDN can make them available whenever and wherever they are needed.

Medical Patient Data Systems

Pacific Bell's *HealthLink* and *PhysicianLink* offer both hospitals and physicians a better way to cope with, access and use the growing tide of patient information that is often stored in many locations. Increasingly based on the speed and flexibility of ISDN, the system gives doctors and other health-care providers quick and full access to stored data such as:

- *Doctor's notes* made during a patient's office visit, prescriptions and the like.
- *Results* from urine, blood and other tests prepared in a range of locations.
- *Patient records*, surgical proceedings, medicines prescribed and administered, as well as x-rays and other images generated during a hospital stay.
- *Radiological images* generated at specialized laboratories.
- *Insurance and billing* records.

The results are much more streamlined information flows, better data for physicians, faster and better diagnoses, and much better, more efficient health care.

Medical Video Conferencing

Linking doctors to their patients through video is in its infancy. Yet progress is being made. In several locations, physicians are using ISDN video links combined with other types of telemetry for more frequent "visits" to nursing homes, terminal-care facilities, clinics and the like. What these sessions lack in personal contact, they make up for with frequency, and the accessibility to a doctor that patients now have. Doctors make rounds efficiently, without extensive driving or other logistics.

PRINTING AND PUBLISHING

Nowhere has the impact of digital technology been greater than in the family of industries that includes printing, publishing, graphic arts, advertising, photography, illustration and writing. For in each of these areas, computers have first aided, then replaced virtually every process and system.

Digital art. *The images in this guide, as an example, were first drawn by an artist and scanned, then processed and transported completely in digital form.*

Today, almost every element of a printed document either begins its existence in a computer or is quickly made part of a computer file. For example, copy is written and images are drawn or scanned on desktop computers. Pages are designed and formatted, photos corrected and separated, and negatives or even final printing plates produced on these and other systems. Meanwhile, writers and artists, agencies and clients review, edit, revise and approve work at almost every step – either on their own or similar desktop systems. In fact, the only step in the process that is still not digital is the daily caravan of messengers and couriers that carry copy and proofs, disks and cartridges from one system to another.

Now, however, the speed of ISDN is beginning to make even the electronic transportation of this material a reality.

Macworld

Macworld has consciously set out to integrate virtually every practical element of "desktop prepress" into its top-quality monthly magazine. Also an early adopter of ISDN, the publication makes the contents of each issue available to sister publications around the world. According to Chip Carman, Technical Manager for the publication's Global Product Support Center, *Macworld*'s twenty six editions worldwide can use international ISDN connections to regularly view finished layouts, and download pages.

In addition, Carman electronically publishes a catalog of thumbnail photos and illustrations that let editors from other IDG publications select and download images. Most often, they download low-resolution copies for sizing and position, knowing that matching high-resolution files – many 60 megabytes and more – will be transferred on the CD-ROMs Carman distributes every month.

Digital Pre-press International

Dr. Sanjay Sakhuja of DPI is known worldwide for the expertise and precision he brings to a broad range of prepress activities. One of the primary activities at his rapidly expanding facility in San Francisco is turning slides, illustrations and other graphics into accurate printing separations in four and sometimes more colors. He and his staff print many of these as reproductions and posters on DPI's high-quality printers, but just as often these high-resolution files are kept for later inclusion in finished brochures, books, magazines and more.

While a small army of messengers and couriers still visit DPI each day, with incoming slides and illustrations as well as outgoing prints and negatives, more and more work is being transported electronically through ISDN.

"The speeds of ISDN make it much more practical for the large files we handle," says Dr. Sakhuja. Where ISDN is most useful is in returning low-resolution files to designers and publishers, and receiving back full production-ready layouts – with the *lo-res* images sized, cropped and positioned. DPI then replaces low-resolution images with their high-resolution counterparts, does page imposition, and ultimately prepares fully separated color negatives – up to 33" x 44" in size – customized for the actual press to be used.

"The speeds of ISDN make it much more practical for the large files we handle."

Dr. Sanjay Sakhuja
Digital Pre-press International

Much of the proofing within the process is also done through ISDN. This "soft proofing" lets clients view finished work on-screen to make sure their ideas have been carried out exactly.

The San Francisco Examiner

The *San Francisco Examiner Magazine* takes this process one more step. Using ISDN, the weekly publication incorporates DPI into what Director of Development Chris Gulker calls a *"distributed work model."*

The entire publication, in fact, works as a *virtual newsroom* that includes a small inside staff, writers in other parts of the daily newspaper, a nationwide corps of free-lancers that includes a Washington corespondent, a cross-word puzzle expert in Florida, a "people and styles" columnist in Colorado, and more. All are linked to the magazine in a variety of ways, from ISDN and the *Internet* to *America On-Line*.

"It works amazingly well," says Gulker. "What could be a logistical nightmare is really quite simple and straightforward. Our small staff, linked mostly by phone lines, still puts out a magazine of 64 to 72 pages every week." ISDN plays a major role when the magazine begins to come together in Macintosh computers. Copy is pulled in from many sources, edited and sent to the networked Macs. At the same time, photos are messengered to DPI for scanning, and *lo-res* files transmitted back through ISDN to two art directors, who design and lay out the magazine. Finished pages are downloaded to DPI, again by ISDN, where positioned images are replaced with their *hi-res* counterparts. DPI then does page imposition, prepares proofs, and produces final separated negatives for the printer.

"ISDN lets one of the finest prepress facilities in the country become an integral part of our virtual newsroom," says Gulker. The publication also contemplates installing combined frame relay-ISDN links to the *Internet*, to better unite its office and far-flung staff.

ISDN Helps Database Systems Come of Age

4

By completing the digital loop to end users, ISDN has begun to dramatically alter the process of finding and gathering information through the computer. It not only increases the speed with which we access information, but is changing the information itself – offering more options in the way it is formatted, stored and presented. It is even giving rise to a new type of system for archived images and other large files.

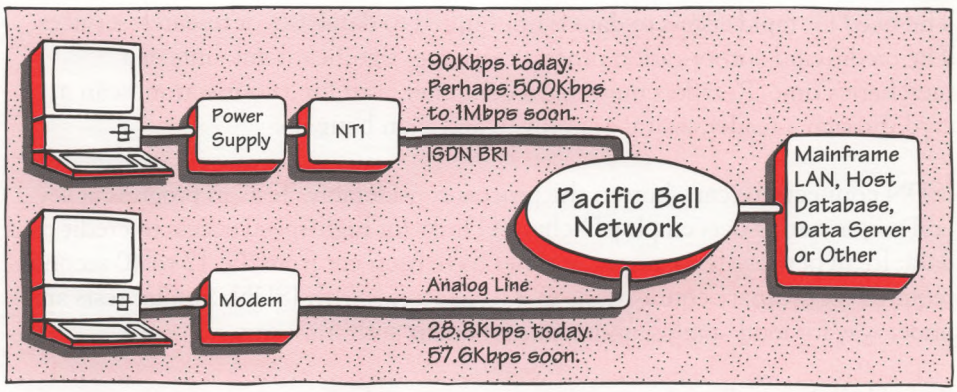
DIGITAL ACCESS TO THE FACTS YOU NEED

ISDN will significantly change the visual presentation of many existing information systems such as *CompuServe*, *America On-Line*, *Prodigy*, *GEnie* and others – including professional and amateur bulletin boards.

Access to On-Line Information

Greatly increased speeds will let these services begin to incorporate a wide range of graphics – photos, drawings, illustrations, charts and diagrams – few of which are practical now through traditional modem links. For example, users say *Prodigy* – with its heavy use of text-based graphics – now "sparkles" when accessed through a single ISDN B channel. As ISDN grows, elaborate images will begin to appear more widely in most on-line services and BBSs.

Even leading-edge systems, such as *Lexis*, *ABS Dialog*, and a broad range of business, chemical, engineering, mapping, demographic and similar data sources are beginning to offer more complex graphics, and user-friendly graphical interfaces.



How fast is fast? *Effective throughput of ISDN compared to today's modems.*

Mosaic on the *Internet*

"When I first used *Mosaic* . . . my seven-year-old son was at my side. He asked if he could *navigate.* I watched as he visited places around the world, including a particularly fascinating collection of art at the first Fractal Art Museum at the University of Rennes outside Paris. After viewing one particularly lovely Mandelbrot picture, he simply clicked on it to bring it over to our PC, display it full size on our screen, and store it on disk."

Dr. Tony Rutkowski
Vice President, Internet Society
Director, Technology Assessment, Sprint
Research Associate, MIT

Access to the Internet

One of the major uses of ISDN, especially for smaller users, will be for high-speed access to the *Internet* – the government-sponsored information highway that incorporates and interconnects the nation's most sophisticated research systems and data repositories. It offer many things to many people – from worldwide electronic messaging to a seemingly limitless wealth of accurate, up-to-date information stored in private and public systems across the nation, and around the world.

Mosaic, for example, one of the *Internet*'s new *distributed information browsing clients*, has been described as "the most elegant, powerful, intuitive, aesthetically beautiful knowledge tool ever created." Like many facilities on the *Internet*, *Mosaic* is free, but it demands a high-speed connection for acceptable results.

Today, many corporate and academic organizations have *Internet* servers, linked to the network by high-speed leased lines. At the same time, public *Internet* servers are beginning to offer full network access to smaller firms and individuals, through dialed ISDN connections.

As Robert Berger, President of InterNex Information Services in Menlo Park, said, "Using two B channels, ISDN offers ten times the speed of an analog modem. And prices are now at levels that make the *Internet* very attractive."

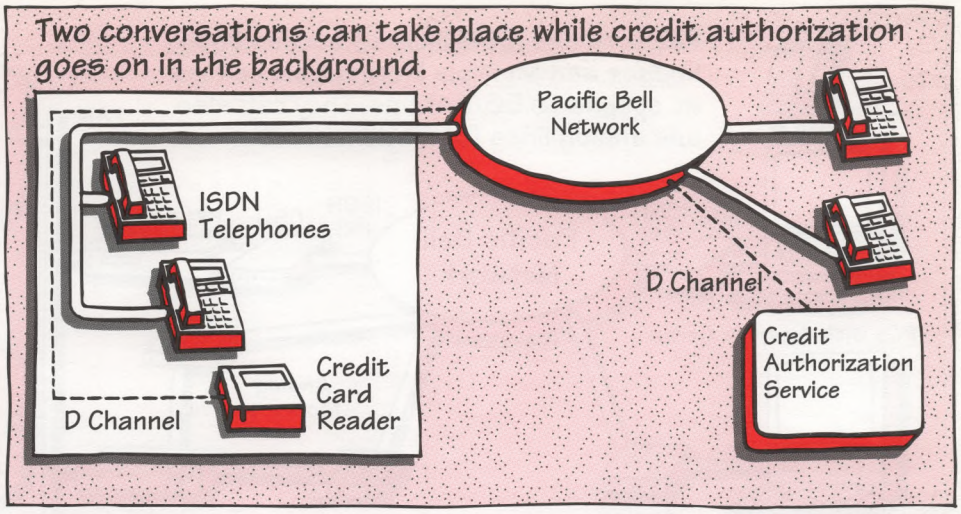
Credit Card Authorization

The need for rapid access to data is not limited to databases or research services. The credit-card authorization process consumes significant amounts of a merchant's time. Retailers must dial a computer, wait for a connection, scan a card through a reader, wait for approval, and then hang up.

ISDN connections can shorten the process considerably. Tests in progress at several major card issuers employ D-channel links for high-speed access to credit card data. In all of these tests, response times have been cut from the 12 to 40 seconds required for ordinary connections to 4 to 7 seconds with ISDN. Similar tests are under way for food-stamps, and medical benefit authorizations.

An added plus in all of these applications: voice telephone conversations can go on uninterrupted while card authorization takes place in the "background."

Credit card authorization using the ISDN D channel. *Response times have been cut dramatically.*


Two conversations can take place while credit authorization goes on in the background.
Pacific Bell Network
ISDN Telephones
D Channel
Credit Card Reader
D Channel
Credit Authorization Service

Stock Quotes for Brokers

Several major equity brokerage houses in California also use the D-channel to update stock quotes displayed on the terminals of their representatives. Real-time exchange prices are downloaded through dedicated links to a central computer, then forwarded to the brokers' PCs through packet-switched D-channel connections. Voice conversations are unaffected.

IMAGE ARCHIVES: A NEW KIND OF SYSTEM

In many instances where CD-ROM laser disks are being used today, ISDN-based archive systems have begun to offer faster, more convenient access, more up-to-date information, and significantly lower overall costs. Some of the digitally stored information ISDN can make available includes X-rays, CAT-scans and other medical images, full-color photographs and illustrations, general and specialized encyclopedias, medical and other professional reference works, repair and service manuals and parts catalogs, film and television images, music and sound libraries, and even virtual-reality simulations, games and other visually intensive files. Especially when information is updated, revised or added regularly, the currency of ISDN access makes it particularly valuable.

High-Quality Images Help Sell Real Estate

RealtyLink is the first multiple listing service built specifically on the speed of ISDN. Developed by the San Fernando Valley Board of Realtors and Pacific Bell, it stores and makes available photos, renderings, floor plans and other images, as well as title and assessor's documents scanned into the system.

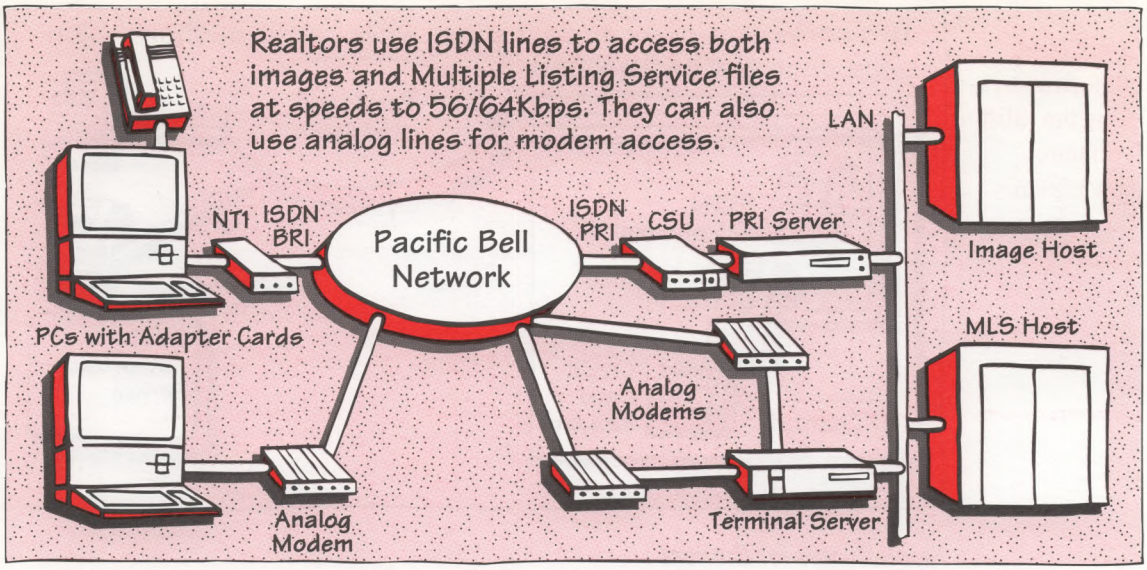
While many computerized MLS systems exist, ISDN-based *RealtyLink* is the first to make the transmission of high-quality images practical. Full-screen color photographs, for example, are drawn on a broker's screen in 5-8 seconds.

The IBM *WaveRunner*

IBM's innovative digital modem, the *WaveRunner,* is indicative of the imaginative ways manufacturers are responding to users.

In an ISDN environment, the device acts as a standard ISDN terminal adapter, linking a PC or workstation to an ISDN BRI. When the user wants to use or communicate with a non-ISDN device, however, the *WaveRunner* automatically transforms itself into a standard high-speed analog modem.

The result, the user interconnects to any device or location at the highest speed supported, digital or analog, without worrying about protocols, capabilities or electronics.



Systems use the IBM *WaveRunner* card, which also lets brokers access standard analog faxes and modems. Future plans include fully narrated, full-color video tours of a property or area to be called up at a broker's command.

RealtyLink. *The system offers not just MLS information, but photos, drawings, plans and other graphics, as well as electronically stored title, escrow and other documents.*

Also in development is an ISDN-based system to capture and make available the documents needed to complete a real estate transaction – escrow forms, title and lender guarantees and the like. By scanning these at their point of origin, and making them available to brokers statewide as needed, the real estate industry is rapidly approaching its goal of eliminating the transfer of paper within five years.

Electronic Manuals

Many operator, maintenance and repair manuals, for computers, airplanes, automobiles, electronic and medical equipment, and other items are being "published" thorough ISDN. According to an industry newsletter, *ISDN News*, a range of corporations in Europe – where nationwide ISDN networks have existed for a number of years – successfully use such systems. At any time engineers, technicians, repair facilities and others can refer to and download the most current documentation. Manufacturers eliminate the costs of printing, storing and distributing massive documents. Users do away with the drudgery of maintaining and updating them.

Photo Retrieval Systems

Today, in France, most larger photo agencies, such as Gamma, Sygma, Magnum and Kipa, now let their customers – including newspapers, magazines and television stations – use ISDN connections to electronically select photographs. Using standard PCs or workstations, editors view a selection of current or file photographs, and call up full-screen images of individual items. They can also request thematic searches, try out image zooms and crops, and place orders for photos they choose. High-resolution digital copies of the images can be downloaded, or traditional photographic materials sent by messenger.

The same type of system has now appeared in California. *Allsport*, a sports photo agency in Santa Monica, currently lets editors, agencies and others view screen images for some 10,000 of its full catalog of 6 million photos. Viewers select images on-line, and download high-resolution files. According to Allsport's Steve Powell, the agency is scanning about 300 images a day for use in this new service.

ISDN Produces Better, Less Costly Meetings 5

Many who work in large organizations spend much of their working day in meetings. Meetings are, in fact, one of the primary ways companies plan, set schedules, solve problems, and make decisions. They are often pivotal events where the future of a product or even a company can be shaped.

Yet, as almost anyone in business knows, effective, timely meetings are quite difficult to plan and schedule. Out-of-town meetings, in addition, have also become very expensive.

A growing range of organizations have discovering that carefully structured electronic meetings not only save money, but are much easier to arrange – with key people less likely to cancel. They have also found that these meetings are frequently much more productive:

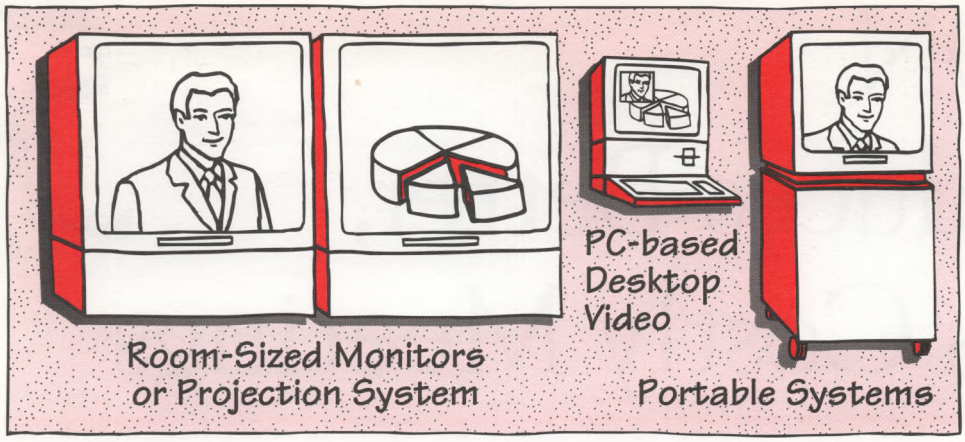
- Each participant can be better prepared to make or endorse decisions, commit to deadlines, and allocate resources, because each has access to the information, advisors, schedules, documents and data they use every day.
- Electronic meetings also seem to promote a more systematic agenda, lessen the tendency to stray from a subject, and dramatically reduce outside and after-hours distractions. It has been said that today it takes less time and effort to *hold* a meeting than to *schedule* one.

GROWING TELECONFERENCING OPTIONS

To support this growing thrust toward electronic meetings, a wide range of video and audio conferencing systems is becoming available – much of it specifically designed to exploit the speeds and channel flexibility of ISDN. In fact, using equipment available today, it is possible for even the smallest office or business to gain the advantages of dynamic, on-the-spot teleconferencing.

The Traditional Video Conference

The use of traditional full-motion, full-color video conferences is virtually exploding as equipment costs come down, and the availability of inexpensive dialed ISDN lines goes up.



ISDN video conferencing *offers a range of equipment sizes and costs. High-end applications can combine, or bond, multiple ISDN channels for maximum video quality.*

In these meetings, groups at two or more locations are photographed, usually by camera operators who add close-up zooms and other variety. The TV signals are transmitted through broadband digital connections – usually 384Kbps and above – and displayed at each of the other locations. Traditionally, speeds in this range required dedicated broadband lines set up especially for the purpose, or leased virtual connections set up for specific daily or weekly time segments.

With ISDN, it is possible to simply set aside an appropriate bundle of B channels through a corporate PRI, or for a smaller company to combine several BRI connections. When the meeting is over, usage charges stop, and lines can be returned to the normal pool of ISDN facilities.

Picture Phones and Video Mail

A range of equipment manufacturers in the United States, Europe and the Far East have demonstrated compact videophones that embody a range of voice, video, fax and computer capabilities.

Today, video conferencing can take place through a PC. In a few years, we may be just as comfortable with video telephones that incorporate many of the mouse-driven functions of a computer – so that we can not only see the person we're talking to, but share documents, photographs, maps, spreadsheets or just about any other computer stored file.

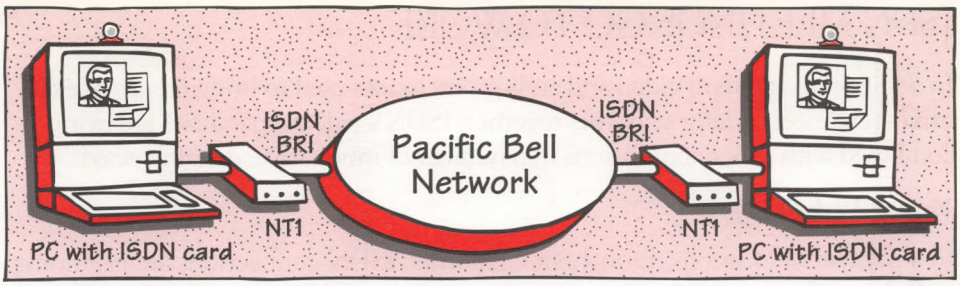
In addition, just as automated voice messaging has become common today, video mail is ready to add yet another channel for bringing people and ideas together.

Midsize Video Systems

Portable video systems are designed basically for smaller meetings. They offer good image clarity, and the potential for full-color, full motion images. What makes them special is that they accommodate, through reduced color or slower image-refresh rates, to the line speed available between two locations.

Good quality video, in fact, is today possible through as little as 112Kbps – the capacity of a single BRI connection – and many smaller meetings today are being held through this type of system.

Desktop video systems *let users see and talk to each other, and work together on documents or files.*



Desktop Video

PC-based "head-and-shoulders" imaging through the computer screen can bring several people face-to-face, without the burden and expense of travel, or without the need to leave the office, or in fact to even leave home.

Desktop video today is one of the most rapidly growing areas of ISDN – for telecommuting, small executive meetings, sales and sales follow-up, and a host of other activity. The potential for exciting new applications is enormous.

Audio Conferences Come of Age

ISDN also makes inexpensive audio conferences increasingly useful, and practical. Instead of speaking and listening to narrow-band transmissions through an analog speakerphone, it is now possible to capture speech through high-quality microphones, and deliver it anywhere in the world with the full quality of digital sound – free of static, line noise or other distortions.

These meetings can be set up at a moment's notice through dialed ISDN connections. Supporting channels can also carry a range of visuals, such as fax, shared computer screens and electronic blackboards.

The Flexibility of ISDN

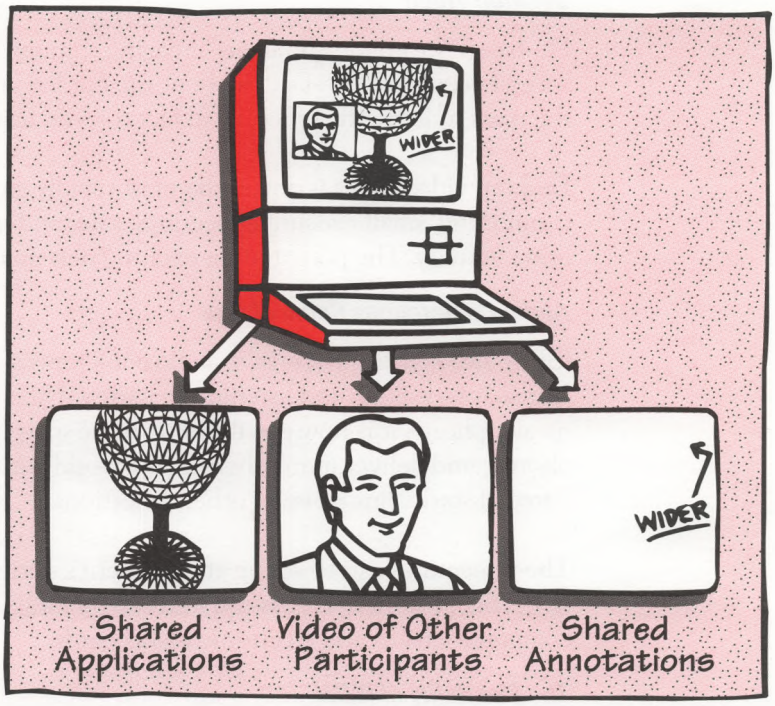
ISDN also helps larger organizations, especially those that have a number of meetings each day between varying locations. System managers can choose the most cost-effective transmission systems and speeds for each application need, and allocate ISDN channels accordingly.

ISDN MEETINGS GO TO WORK

In addition to standard video and audio conferences used to bring groups of executives, engineers and/or scientists together, ISDN's video capabilities are being combined with other applications in a number of innovative, dynamic ways.

Virtual Work Groups

In a number of locations throughout California, ISDN connections are beginning to link people in many different disciplines, offices and locations into permanent or temporary *virtual work groups*. Using dialed BRI lines, they communicate, share documents, files and messages, interconnect to LANs or other networks, conduct video meetings and in general interact with one another in much the same way they would if they shared an office.



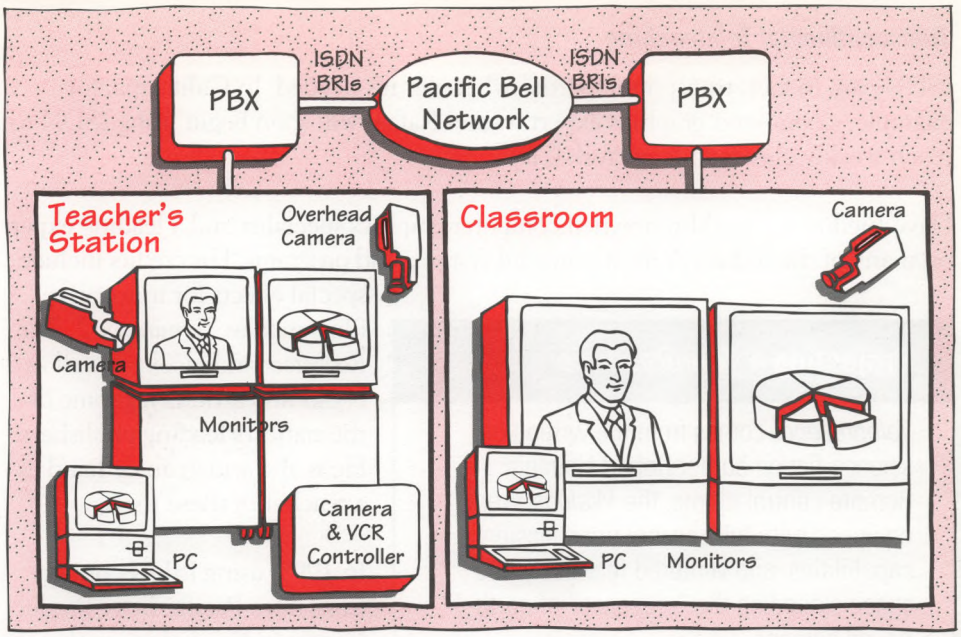
ISDN virtual workgroups and team collaborations *bring people together. Work can actually be more productive than in an ordinary meeting.*

At Jet Propulsion Laboratory, for example, *Multipoint Bridge Conferences* link scientists and engineers from many locations in a range of system-design, CAD/CAM and other similar meetings.

Worldwide group or team collaborations, in fact, are rapidly becoming practical in a number of disciplines. A consultant in Silicon Valley uses as many as 12 ISDN B channels for regular CAD/CAM design collaborations with a number of engineers in Japan. The dialed ISDN connections link Sun Workstations for:

- A CAD/CAM application shared by, and usable by all participants.
- Two-way desktop video and voice connections to all participants.
- A shared whiteboard where all can make annotations, gesture with on-screen markers, make rough drawings and the like.

The team can also share documents, faxes or virtually any other form of electronically stored information.



A typical distance-learning configuration. *Bringing teachers anywhere in the world.*

Distance Learning

A broad range of educational institutions are beginning to use ISDN as the backbone for integrated voice, data and video transmissions that bring expert teachers face-to-face with students in remote classrooms.

In a more elaborate set-up, classroom TV screens show the teacher and any visuals being used, while a camera in the class lets the teacher see and interact directly with students.

A simpler set-up might include a desktop video between a teacher and several students, a screen-sharing link for visuals and interchanged materials, and perhaps a remotely controlled computer screen showing documents, images, data or almost anything else. ISDN connections, in fact, can effectively handle almost any combination of voice, visual and data interchange.

Corporate Training

Similar educational needs exist in the corporate world, where expert trainers must either travel to the trainees, or the trainees must travel to the experts. In either case, expenses mount rapidly, and key people are taken away from their primary jobs for extended periods.

ISDN-based remote training is an ideal solution, and lets experts from many locations interact with trainees at many other locations – using whatever video facilities and visual aids best support their objectives.

Teachers for Rural and Inner-City Schools

ISDN-based systems are currently bringing expertise in mathematics, science, foreign languages and other specialties to a growing number of geographical areas where these disciplines are in critical supply. Distance learning projects are currently being developed in a range of inner-city schools, as well as in several rural districts. As noted earlier, Pacific Bell's *Education First* program is putting four ISDN lines into every public school and library in California.

Transcontinental Teleteaching

ISDN can, in fact, transport expertise wherever it's needed. In California, for example, a computer graphics expert in San Rafael will soon begin using ISDN to teach weekly classes in New York City.

Dave Biedny is a world-renowned computer graphics specialist and a leading expert on many of the industry's most powerful systems and programs. His credits include special effects for innovative films such as *Terminator 2*, *The Rocketeer* and *Hook*, as well as books and articles for some of the nation's leading publishers. He is also widely in demand as a teacher of these tools.

In 1993, using ISDN connections from Pacific Bell's Product Center in San Francisco, he conducted a demonstration class in Adobe *Photoshop* at the renowned School of Visual Arts in Manhattan – some 3,000 miles away.

"I think the students and I were all amazed at how successful it was," said the artist. "We used several ISDN lines for voice connections between the sites, for remote control of a Macintosh in New York using *Timbuktu*, and for video links carrying me to the class and the class to me. Later in the session, students took control of the Mac, and I critiqued their work as they presented it." With ISDN now becoming available in the North Bay, the videographer plans to use it to begin holding a regular weekly *teleclass* in New York, and perhaps several other locations.

Projecting a *Telepresence*

Telepresence comes from the writing of science-fiction author Robert Heinlein. Remote-control robots, the *Waldos*, were equipped with full sensory transmission capabilities, and ventured fearlessly into space extending the "presence" of earth-bound humans.

"Good teachers can go anywhere, too," says computer graphics innovator Dave Biedny. "But generating and projecting a *telepresence* that works today involves many things – sight and sound and images – even robotics if we get there (I like to throw things in class). The teacher needs to *transport* as much of himself as possible to those he's trying to reach.

"But it all takes bandwidth, and lots of it. I have high hopes for ISDN."

Selling Produce to Japan

Strawberries may seem like unlikely candidates for an international video conference, but today strawberries, artichokes and an entire market basket of fruits and vegetables are having their images beamed around the world through ISDN.

The Japanese are sizable consumers of fresh California produce, but they are also hesitant to buy without first seeing the product. Once, this meant shipping samples, packed in dry ice, by air. The cold sometimes altered the product, yet even when it didn't, prime picking times might have passed before a decision was made.

Today, buyers throughout Japan see freshly picked products on live video transmissions using single BRI connections from sites throughout California. Colors and products are at their best, and sales are greater than ever before.

The Voice of Tomorrow

6

Using a digital network for voice conversations may seem like an anomaly. After all, analog connections do a fine job of linking the voices of people around the world – and have for the better part of a century.

Yet the simple fact is that digital voice is better. And quieter, clearer conversations are only the beginning.

The simple fact: digital voice is better.

Two Conversations on the Same Line

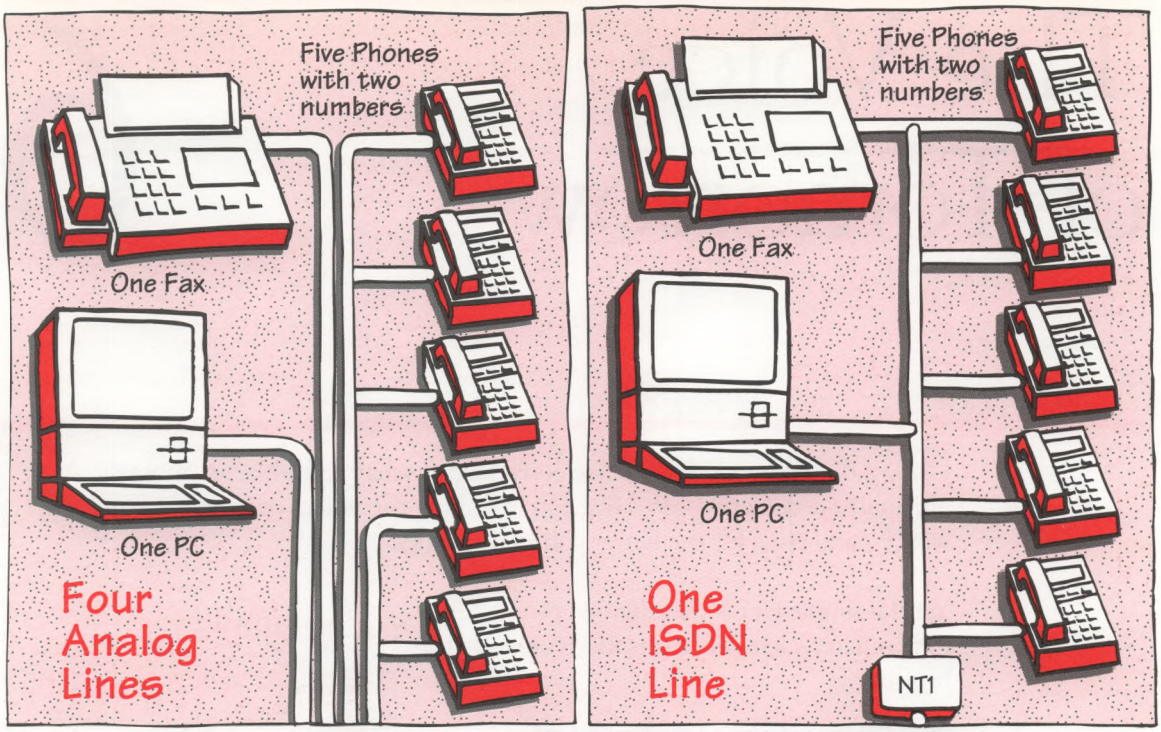
ISDN enables two separate voice conversations to take place, at the same time, through the same single twisted-pair telephone wire that traditionally, in an analog environment, carried only one conversation. What's more, since ISDN delivers two separate channels through the wire, it is also possible to conduct a conversation on one channel, and simultaneously use the other for a data device such as a PC or facsimile machine. These multiple "conversations" could also take place while the speaker or someone else used the D channel for a third simultaneous transmission.

But that's only a start.

The Advantages of ISDN Voice

It is also possible to attach up to eight devices – telephones, computers, faxes and more – on every BRI connection, and to give these devices as many as 64 "call appearances" of the same telephone number, or virtually any combination of different numbers.This feature alone offers enormous advantages. A few examples will show why:

- In a busy sales location, several representatives who are frequently out of the office might share a series of numbers on a single ISDN line. Each incoming call could be answered correctly ("Jane Green's office" or "Dan Brown's line"), yet theoretically as many as 64 representative, served by up to eight telephones, faxes or PCs require only one ISDN line – not the many lines currently needed.
- A busy individual might have two or more "appearances" of a single number on an ISDN telephone, as well as different numbers linked to a PC and/or a fax – so that incoming calls could be answered by the appropriate device. At any time, a voice conversation on one call appearance could be put on hold, and another voice call made or received on another call appearance. These calls could even be conferenced into a three-way conversation. Yet all of this takes place through a single ISDN line, not the three or four required today.



The economics of ISDN. A *typical analog office or department vs. the same office with ISDN.*

While only two actual conversations, or PC or fax transmissions, or any combination of these, could take place at the same time, all devices share the same line.

What's more, multiple data devices – such as credit card units, PCs, remote sensors or the like – could all contend for and use the packet-switched D channel at the same time that two conversations take place on the B channels.

Easy-to-Use Call Management

ISDN also offers better call management. Not only is the range of features extended, but the telephone's liquid-crystal display (LCD) is linked to the ISDN D channel so that useful telephone functions are no longer buried in a complicated system of double presses and two-second holds.

"We can take today's office phone system, with all those features you can't figure out how to use, and put a screen on it, and make it do what we want. We can even do simple video conferencing . . . "

William Gates, Microsoft Chairman

Rather, they become as quickly available as pressing a button on an automatically displayed menu.

Normal ISDN BRI links, such as those offered by Pacific Bell, include the most widely used features:

- *Hold.* For anyone who has inadvertently disconnected a caller rather than put them on hold, the easy use of this capability will make it the important tool it should be.
- *Three-way conference.* Adding another voice to a conversation is a powerful feature, yet one rarely used. With ISDN, it can be as simple as touching a button and dialing an extension.

✦ *Call transfer.* Again, an important feature. Used by receptionists and operators, who use it enough to remember, but rarely by anyone else. ISDN makes it almost automatic.

Extended Call Management

For those who take advantage of Pacific Bell's ISDN Centrex service, or those in a larger organization or campus served by their own comparably equipped digital switch, the range of call management features can be greatly extended. Some of these include:

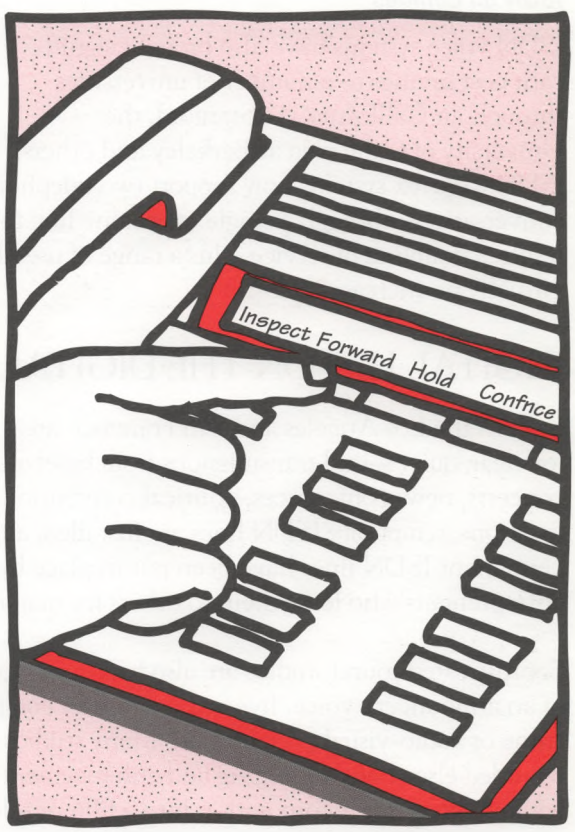
✦ *Call Forwarding.* Forwards calls to a preselected number when the called number is busy, or after a preset number of rings.

✦ *Call Pickup.* Lets an incoming call be picked up at another station.

✦ *Directed Call Pickup.* Lets calls from a specific extension be automatically forwarded to a second number.

✦ *Message-waiting Indicator.* Shows that an incoming voice message has been received.

✦ *Directed Dial.* Incoming calls can be automatically forwarded at the Pacific Bell central office to a car or mobile phone or a phone at another location.



An ISDN telephone. *Softkeys offer quick, effortless access to features and functions. The "inspect" button displays additional features.*

Called *virtual key,* these features make Centrex a formidable competitor to in-house PBX or key systems. The Pacific Bell switch becomes, in effect, the "PBX" serving a location. It offers extended functionality and the potential for unlimited growth and enhancement – with virtually no capital investment or risk of obsolescence.

Centrex systems also offer full-channel (that is, 64Kbps per B channel) data speeds within an organization, and extended control of how inter-company calls are handled. An organization with several smaller offices in an area – a real estate firm, for example – might link its locations with a customized yet easy-to-use array of call-forwarding, paging and call-pick-up options.

The Weiss Building

The Weiss Building, a Pacific Bell office in the San Jose business district, has become a demonstration point for how ISDN can bring the full benefits of digital telephony to an organization.

Some 580 Pacific Bell employees located in the building were simultaneously converted to ISDN. Careful financial records were kept to determine whether or not Pacific Bell – as a customer – spent or saved money with the new service.

The results amazed everyone. The ability of ISDN to support multiple devices through a single connection dramatically reduced the number of physical telephone lines required at the location. Some of the results: clearer conversations, better call management, dramatically higher data speeds, and annual savings of more than $1 million.

The results amazed everyone: clearer conversations, better call management, dramatically higher data speeds, and annual savings of more than $1 million.

ISDN on Campus

ISDN voice systems have also brought significant cost savings to a number of universities throughout California. At Stanford, the University of California at Berkeley and others, ISDN Centrex systems now support two telephones, and two simultaneous conversations, through a single telephone line to each dormitory room. The result: a doubling of service, plus a range of useful call management features, at virtually no increase in cost.

DIGITAL HIFI ON THE DIGITAL HIGHWAY

In both the Los Angeles and San Francisco areas, radio stations now use ISDN for clear, quiet sound transmissions from baseball, basketball and other games, concerts, news conferences, political conventions and similar events. At most locations, temporary ISDN lines are installed, although at more and more venues, permanent ISDN lines have been put in place by both broadcasters and entrepreneurs who lease them to others for major functions.

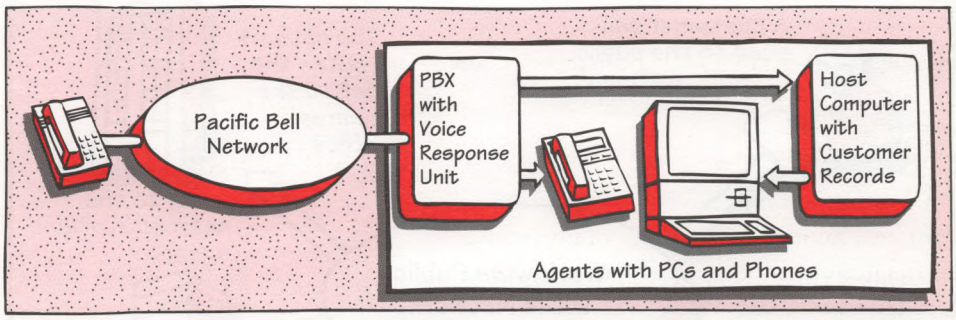
Sophisticated sound studios are also beginning to use ISDN for remote recording of an announcer's voice, live music or other components of a film, video, advertising or audio-visual presentation. Many studios also download stereo tracks recorded elsewhere for mixing and enhancement on their more sophisticated equipment, or for incorporation into a film or television presentation.

Hollywood's Byron Wagner, of Genius, Inc., is convinced that ISDN transmission of CD-quality sound is in its infancy. Wagner is not only an equipment innovator and technology consultant to the entertainment industry, but has been the recording engineer of choice for some of the world's leading popular and country performers.

At a digital media demonstration at *Texpo '93*, he used ISDN lines and state-of-the-art compression to link singers in San Francisco, Hollywood and Hawaii into a single real-time concert. He believes the emerging technology opens many possibilities, from remote concerts, talent auditions and collaborative "jam sessions," to tele-jukeboxes in which customers link their stereo systems to a compact disk library to hear and perhaps even buy new releases or hard-to-find classics.

ISDN IN MARKETING AND SERVICE

Telemarketing call centers and telephone service centers are voice installations that also give representatives access to data stored in a computer. These sites have flourished in the last decade, especially for answering incoming sales calls from advertisements or catalogs, or service calls for parts, repair or assistance.



Basic telemarketing. *The PBX prompts for an account number and delivers both call and customer record to the next available agent.*

Using a range of computers, from small PCs to mainframes, these systems automatically answer each call, prompt the caller for an account number (or in other states, read the incoming Caller-ID number when available), and simultaneously deliver both the call and the caller's computerized record to the next available agent.

ISDN adds a new dimension to these facilities. Because through a single telephone connection, ISDN offers not only a voice connection to the caller, but a simultaneous high-speed data connection to a computer.

ISDN as a Network Controller

"ISDN offers a command and control structure that can actually mold the public phone network to your needs," says Bob Pokress, co-founder and chairman of Teloquent Communications Corporation of Billerica, MA. In effect, he notes, the D-channel command language can transform the network itself into:

- A virtual PBX that has no boundaries, creating what is truly a *virtual office*.
- An automatic call distributor, or more accurately a *call optimizer*, that logically directs incoming calls to agents worldwide.
- A user-controlled link between a computer and voice applications anywhere.

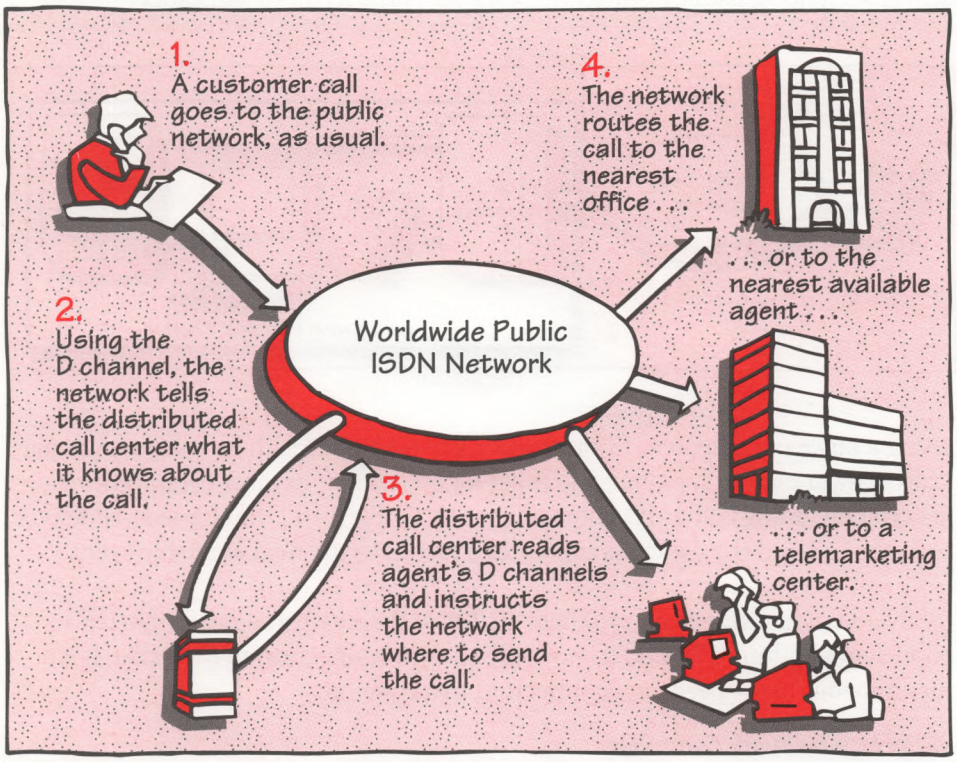
"With ISDN, the power of the network itself can give the enterprising company a major competitive advantage."

Bob Pokress, Teloquent Communications Corp.

Teloquent is one of several companies today offering computer-based systems that lets users communicate with the telephone network in the actual command language used by the network itself. The practical result: companies with many offices statewide or even nationwide can link them all into a single, responsive telephone center. Calls can be routed to the best person, regardless of location. At the same time, calls to a local office where everyone is busy can be seamlessly forwarded to the nearest site with someone available, or even to agents working at home.

According to Pokress, who managed the original ISDN Architecture Group at AT&T Bell Labs in the early 1980s, a Distributed Call Center gives users an enormous ability to shape and manage the network itself through the D channel.

A regular customer, for example, can be routed to a specific sales agent, while someone needing specialized assistance, as entered in initial prompts, can be directed to an appropriate specialist. Distributed Call Centers can also balance workloads, centralize after-hours calling, and work around service interruptions at any site. Call redirection can be programmed by a range of customer options.


1.
A customer call goes to the public network, as usual.
2.
Using the D channel, the network tells the distributed call center what it knows about the call.
Worldwide Public ISDN Network
3.
The distributed call center reads agent's D channels and instructs the network where to send the call.
4.
The network routes the call to the nearest office . . .
. . . or to the nearest available agent . . .
. . . or to a telemarketing center.

An ISDN Distributed Call Center. *The system exploits the power of ISDN to intelligently route the call, using the same D-channel language as the network itself.*

Charles Schwab

One major user of the network-control power of ISDN is Charles Schwab & Co., which is now testing a pilot system with about 10 percent of its brokerage offices nationwide, including many in California. These are supplemented by four large phone centers in Arizona, Colorado, Florida and Indiana. The Schwab objective is to never miss an incoming call, while minimizing the costs of forwarding them through its network of offices.

When agents in a pilot-system office are ready to receive calls, they "log in" with a D-channel message to Schwab's computer-based phone server. They then begin receiving calls, with messages on their phone screens telling them whether the call was to their office, or is being forwarded.

The Schwab system functions as a responsive automatic call distributor, allocating calls to the most appropriate agent, regardless of geography. It can also route calls to agents in nearby offices, or if all agents in all local offices are busy with customers, forward the calls to the nearest Schwab phone center. Costs are minimized, since calls are forwarded locally when possible, yet service levels are maintained at virtually 100 percent.

The results are total responsiveness to every customer, sensible staffing levels at each branch office, and minimum costs for a truly nationwide telephone system.

ISDN and the Power of Packet Switching

7

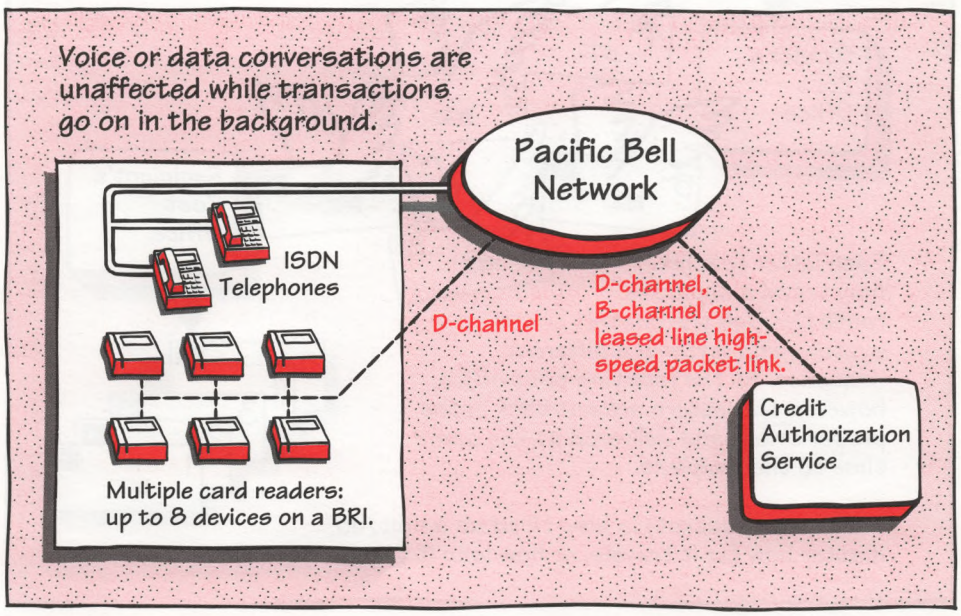
Integrated Services Digital Network is bringing new life, new energy, and a host of powerful new applications to a mature technology that has been in place for more than twenty years.

The technology is X.25 packet switching, and the excitement is being generated by the direct, *permanent* interconnection of the ISDN D channel to this well-established yet still growing communications infrastructure.

ISDN telephones, PCs, data terminals and more become *dialable receiving locations* on the worldwide packet network.

The result: the D channel of an ISDN connection gives virtually any device – cash register, point-of-sale terminal, credit card reader, PC or almost any other data device – *a permanent, full-time link* to the Pacific Bell X.25 packet-switched network and thus – through connections to interexchange carriers or public value-added networks – *to any other computer or data device, on any public packet network, anywhere in the world.* Perhaps a perfect example is the immediate and easy access the ISDN D channel offers to a range of on-line information services, such as *Compuserve* and *GEnie*.

Up to eight devices on a single BRI. *All devices, in fact, could be PCs, point-of-sale or similar terminals. It's also possible for the "device" to itself be an access controller so that even more POS terminals could be linked through a single BRI.*


Voice or data conversations are unaffected while transactions go on in the background.
Pacific Bell Network
ISDN Telephones
D-channel
D-channel, B-channel or leased line high-speed packet link.
Credit Authorization Service
Multiple card readers: up to 8 devices on a BRI.

The potential uses of this full-time connection include:

✦ *Low-cost file transfer and database access*. Users can transfer and share many smaller computer files, send and receive messages, and access information and database services. The speed of X.25 is more than acceptable for these applications.

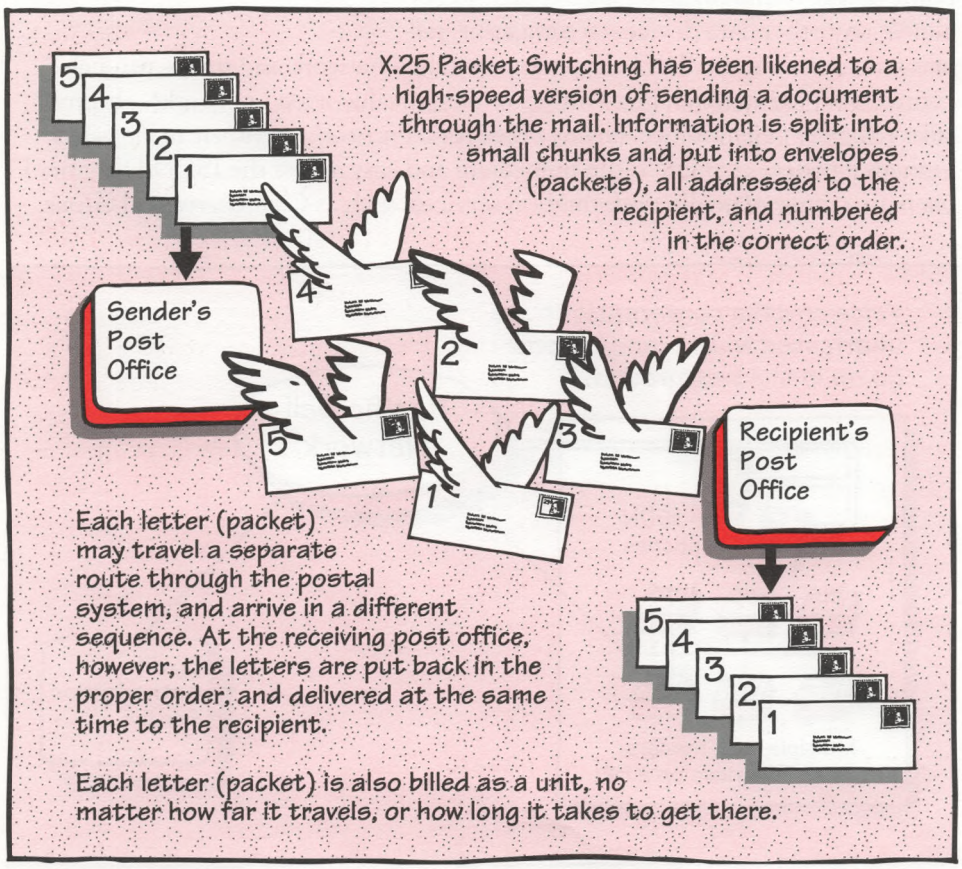
✦ *Transaction processing*. One of the most exciting uses of the D-channel/packet-switching link is for point-of-sale and point-of-service transactions. These range from credit card authorizations and medical insurance processing to "food stamp" debiting and building security.

A perfect example is the immediate and easy access the ISDN D channel offers to a range of on-line information services, such as *Compuserve* and *GEnie*.

What these applications share is the convenience and low cost of ISDN telephone connections. It costs only $4 a month to connect a D-channel device to the X.25 network. In addition, multiple data terminals can share a single D channel (up to a total of eight phones, PCs and other devices on each BRI). Usage rates on the Pacific Bell packet network for ISDN-to-ISDN transmissions within the same LATA (in effect, local calls) are based not on time or distance, but solely on the amount of information transmitted. Transmissions interconnected through other networks may incur some additional charges.

A Concise History of Packet Switching

Defined in the early 1970s, X.25 packet switching protocols are accepted as a worldwide communications standard. Information is divided into small "packets,"


X.25 Packet Switching has been likened to a high-speed version of sending a document through the mail. Information is split into small chunks and put into envelopes (packets), all addressed to the recipient, and numbered in the correct order.
Sender's Post Office
Recipient's Post Office
Each letter (packet) may travel a separate route through the postal system, and arrive in a different sequence. At the receiving post office, however, the letters are put back in the proper order, and delivered at the same time to the recipient.
Each letter (packet) is also billed as a unit, no matter how far it travels, or how long it takes to get there.

X.25 Packet Switching. *Through X.75 interconnections, it's possible to link directly to services or locations on packet networks around the world.*

each of which contains a complete address as well as codes to put it in proper sequence with the other packets being sent. This packetizing is accomplished by a PAD (*P*acket *A*ssembler/*D*isassembler) at the sending end. At the receiving end, another PAD accepts the transmission, puts it in correct order (packets can travel many routes through the network and may not arrive in the order they were sent), and forwards it intact to its destination.

Costs have been reduced from an average of about $.05 to less than a penny per transaction.

Since the X.25 protocol was originally designed for often noisy and interference-prone analog lines, PADs also perform a broad range of error-checking and error-correction functions. If any packet is not received correctly, the receiving PAD signals for retransmission until the packet comes through correctly.

The result is exceptional accuracy through lines that were – and in many areas of the world still are – less than perfect for data transmission.

Today, many of the functions for which packet switching was designed – the transfer of large data files, LAN-to-LAN interconnection, and the like – have been taken over by faster, more modern communications technologies, including dedicated lines, frame relay and the circuit-switched data connections of ISDN itself.

Why Use ISDN for Packet?

The coupling of X.25 to the power of ISDN virtually eliminates the traditional limitations of packet switching. The combination offers:

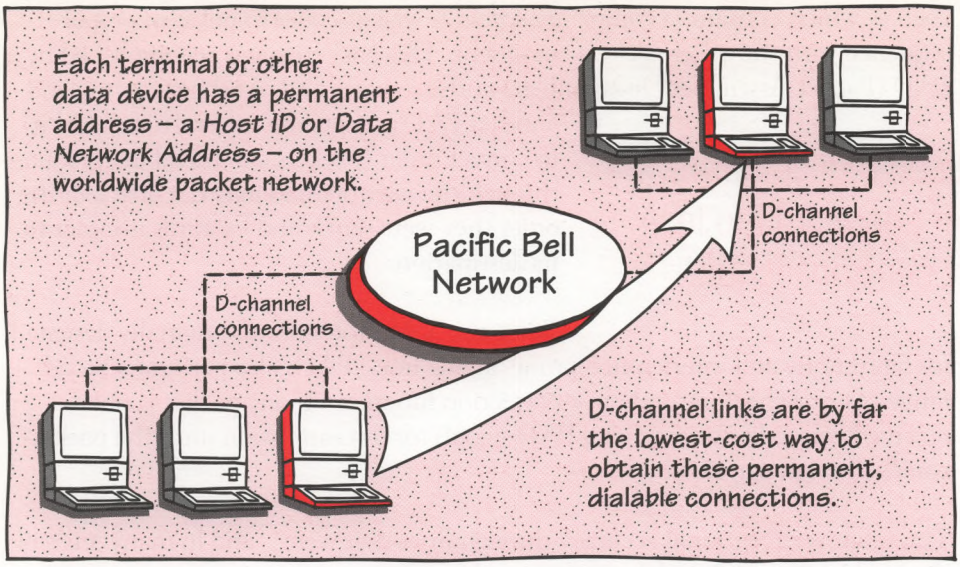
- *Simplified host connections*. A single B channel of ISDN can support hundreds of user X.25 connections to a bulletin board, information service, database or transaction host system. And while user transmissions can originate through either dialed modem links or through permanent ISDN D-channel connections, a host system's permanent, fully digital B-channel link to the packet network *totally eliminates the need for modems at the host site*.

POS transactions are most often completed in two to four seconds.

- *Universal user connections*. Because most ISDN telephones and many ISDN terminal adapters contain PAD capabilities, these ISDN telephones, PCs and data terminals become dialable receiving locations on the worldwide packet network. For example, it is no longer necessary to send messages to a mailbox on a host or information server. Rather, the message can be sent directly to the ISDN telephone or PC at the receiving location.

A PERFECT MATCH: ISDN AND TRANSACTION PROCESSING

If a group of network engineers had set out to define the perfect transmission medium for transaction processing, they would have probably developed a technology that was identical to the one that exists through the D-channel of ISDN.


Each terminal or other data device has a permanent address – a Host ID or Data Network Address – on the worldwide packet network.
Pacific Bell Network
D-channel connections
D-channel connections
D-channel links are by far the lowest-cost way to obtain these permanent, dialable connections.

Each location is permanently connected. *Every D-channel terminal has its own Host ID or Data Network Address. It means that X.25 e-mail and messages can be sent directly to another location rather than to a mailbox for later retrieval.*

It offers:

- *High-speed permanent access*. Because point-of-sale terminals are linked directly to the packet network, there need be no dialing, no waiting. Credit authorizations and other transactions that once took 12-45 seconds are now routinely done in 2-4 seconds.
- *Low access and transmission costs*. In addition to basic ISDN line charges, access to the packet network costs $4 a month for each D-channel device. Up to eight data devices can share, and simultaneously use, the D channel. Transmission costs through the Pacific Bell packet network are based on the amount of data transmitted, not time or distance.
- *Assured accuracy*. Because "point-of-sale" devices range from outdoor gasoline pumps to supermarket card-swipe machines, and because everything from wind-driven rain to dripping ice cream cones must be accommodated, the error-checking/error-correction capabilities of X.25 again offer a major advantage. Credit verification is a perfect example of an application where call-connection performance is much more important than raw transmission speeds.
- *High-speed transactions*. Since the typical point-of-sale/point-of-service transaction contains less than 100 total characters, even the largest takes less than a tenth of a second to transmit. Full POS transactions – from the card swipe to credit authorization – are most often completed in two to four seconds.
- *Simple, easy equipment configuration*. Many ISDN telephones and terminal adapters come equipped with a standard RS232 jack, and contain their own packet assembler-disassembler (PAD). The same RS232 connection is most often used by the majority of today's non-ISDN data devices.
- *Telephones, too*. Each ISDN BRI connection supports any combination of up to eight telephones, faxes, PCs and other terminals, and lets any two of these B-channel "conversations" go on while transactions occur in the background.

A Virtual Transaction Network

In effect, ISDN offers the benefits of a private virtual network yet uses standard telephone lines, and the public telephone network. Across California and the nation, these advantages are being put to use in a growing number of applications.

✦ *A credit card service company* has linked thousands of point-of-sale card readers to its computerized database for credit card authorization and transaction processing. Times have been reduced from an average of more than 30 seconds to less than two seconds. Costs have been reduced from an average of about $.05 to less than a penny per transaction.

✦ *Several major oil companies* are testing ISDN telephone lines to link gas pumps, cash registers and even vending machines into nationwide data networks. Central computers authorize credit purchases, control inventory, and schedule "just-in-time" replenishment of everything from gasoline and oil to candy and potato chips.

✦ A number of *health maintenance organizations* use point-of-sale card readers and ISDN telephone lines to authorize medical insurance benefits and issue payment requests to a range of health-care insurers.

✦ Many *state agencies* are using "food stamp credit cards" to reduce or eliminate the fraud-prone use and collection of paper food stamps. A magnetic card is inserted into the standard card-swipe terminal now appearing in many supermarkets. It quickly authorizes a purchase, and automatically deducts the amount from the card holder's account.

✦ A growing number of *banks* are now linking remote automatic teller machines to a central computer through ISDN and packet switching. The D-channel connections eliminate the need for dedicated lines to the ATM, and make it economical to serve many more locations.

At many corporate and government locations, low-cost D-channel connections are being used for entry to buildings, laboratories, warehouses and other areas.

✦ In several tests, *insurance and real estate agents* are now able to access records from a range of computers. Insurance agents, for example, can retrieve policy information from several participating companies, and real estate agents can often tap into home-for-sale listings from neighboring towns and cities.

✦ Several *state lottery agencies* are experimenting with ISDN-based approaches to playing state lottery and numbers games. The attraction of ISDN is that it uses existing telephone lines, and thus reduces the current dependence on dedicated connections to these statewide systems. It would make lotto terminals much more widely available, almost to any public location that had phone service.

✦ At many *corporate and government locations*, low-cost D-channel connections are being used for entry to buildings, laboratories, warehouses and other restricted areas, as well as for security and other forms of telemetry.

✦ Many *colleges and universities* that installed ISDN for voice and high-speed data connections have found they can economically use student ID cards for meal payments, library check outs, classroom and dormitory entry, test authorization and other applications. D-channel card readers are easily linked to an appropriate computer through the nearest ISDN telephone connection.

Note that in many of these applications, the use of a dialed modem on an ordinary telephone line is simply not practical. Call-by-call connection times are far longer than a customer would wait.

A Key to the Future

"Some of us had begun to write off X.25 as an outmoded, outdated technology," commented Bob Larribeau, an ISDN technology, marketing and applications consultant in San Francisco. "Except for sending files to the third world, it seemed too slow and too cumbersome for today's high-speed data transmission needs.

"Some of us had begun to write off X.25 as an outmoded, outdated technology . . . Then along came ISDN and opened up a whole new world for it."

"Then along came ISDN and opened up a whole new world for it. X.25 packet switching is probably more valuable today than it ever was at any time in the past. For things like credit cards, oil cards, health insurance, ATMs, telemetry and more, it is truly a road to the future."

Putting ISDN To Work

8

Some 60 percent of the central offices in California served by Pacific Bell now have at least one digital switch installed, and by 1997 most Pacific Bell switches will be either AT&T 5ESS or Northern Telecom DMS-100 systems – all designed specifically for a full range of digital services such as ISDN. For nationwide or worldwide applications, it is also possible use Pacific Bell for connections to the long distance ISDN services of the major interexchange carriers (IECs) such as AT&T, MCI or Sprint. Many of these IECs also offer direct access to their own ISDN PRI services, and also provide applications development and equipment selection support. One problem, however, is that – for the present – equipment that works on a Pacific Bell ISDN system may not also function properly on ISDN from another source. The reasons for this problem, and the evolving solution, are discussed in the following section.

Challenges remain, but worldwide ISDN applications are now becoming possible, and practical.

For nationwide applications, other regional operating companies, especially those in the Mid-Atlantic and Midwest, now offer many local-loop ISDN connections to individuals and businesses, and many are also linked to the nationwide networks of the interexchange carriers.

For international applications, many European and Pacific Rim countries offer ISDN connections to overseas commercial centers, and several of these systems are actively used by customers as "hubs" for overseas networks. Worldwide ISDN interconnection is available through major interexchange carriers, with local connections provided by Pacific Bell and other regional telephone companies.

While some limitations do still remain in the nationwide availability and transportability of ISDN, enormous progress has been made. More and more ISDN "islands" have been linked to each other, and to the ISDN networks of many national and/or international carriers.

The Variations in ISDN Services

Yet one of the major factors slowing the growth of ISDN is the slight but often critical differences between services from various sources. ISDN service from AT&T, for example, is different from that offered by Pacific Bell, and both in turn are different from services offered by other IECs and regional operating companies.

The problem, of course, has been recognized, and is being fixed. In February 1991, Bell Research Corporation (Bellcore) issued a technical specification for what is called National ISDN-1. It attempts to standardize the ISDN services offered by the seven regional operating companies – the owners of Bellcore (one of which, of course is Pacific Bell) – and serves as a recommendation to other communications companies in the United States.

Several interexchange carriers, however – such as AT&T, MCI and Sprint – do not adhere exclusively to these recommendations. Since National ISDN-1 specifications do not include a number of features – and thus equipment connections – that these companies believe are important, they all currently offer separate version of what is generically called *Custom ISDN*. In many cases, telephones, terminals and other devices for these services do work with the ISDN systems offered by regional and other carriers.

The Movement Towards Worldwide Unity

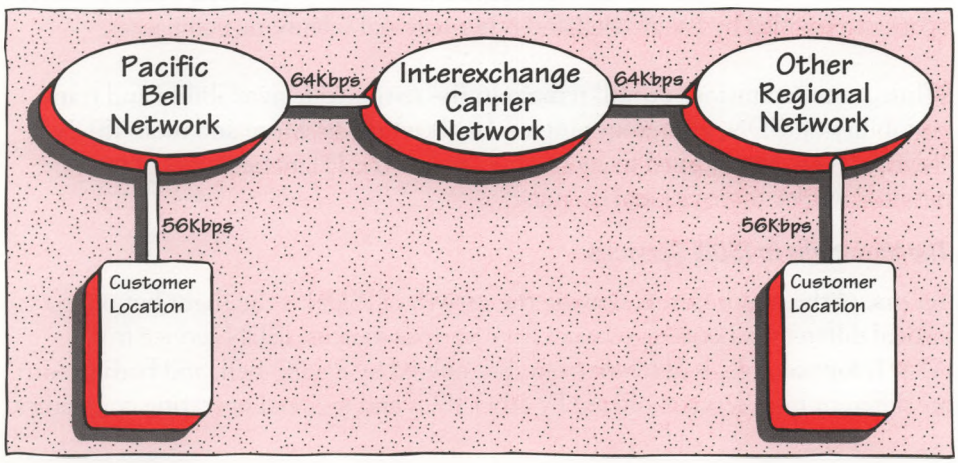
Nevertheless, much of the difficulty of interconnection is being overcome by the telephone companies, and by digital switch and ISDN equipment manufacturers. Specifications for National ISDN-2 and ISDN-3 have also been defined. These versions, which progressively add service and equipment capabilities, should ultimately make all ISDN services in the U.S. identical, or at least fully compatible. These specifications are targeted for nationwide implementation in coming years.

In addition, the availability of local ISDN PRI and BRI services is growing rapidly throughout the nation. Full digitalization of many regional networks has been scheduled, and ISDN interconnections to the backbone networks of the IECs are now proceeding at a rapid pace.

Extending ISDN with Switched 56 Services

It is also possible today to establish ISDN-compatible data links to out-of-state locations not served by ISDN, by using Switched 56 services.

The major interexchange carriers, all regional operating companies, and many specialized international carriers offer Switched 56 services. These are single-channel, dialed, data-only connections, capable of speeds up to 56Kbps. Virtually all are connected to the interexchange carriers' nationwide digital networks, and thus to each other.



Nationwide ISDN interconnection. *Interconnection from one network to another is now possible. Rate adaptation is most often automatic.*

Examples of ISDN applications that can be effectively extended through Switched 56 services are those that:

- Do not depend on voice transmission,
- Do not use several channels simultaneously for multimedia transmission,
- Do not need data speeds substantially greater than 56Kbps,
- Do not depend on the call-by-call intermixing of circuit-switched and packet-switched data, and
- Do not depend on out-of-band D-channel signaling.

ISDN SERVICES FROM PACIFIC BELL

Pacific Bell today offers ISDN connections through virtually all of its digital switches. As described below, many of these switches can, in fact, provide both standard and Centrex versions of the BRI interface.

SDS ISDN and Home ISDN

Switched Digital Service ISDN is Pacific Bell's implementation of the standard ISDN BRI for businesses. It offers integrated voice, data and video transmission over a single phone line, with the quality and increased data speeds of digital transmission. A virtually identical service – Home ISDN – will also be available for residential installations.

For voice calls, SDS ISDN offers exceptional flexibility. It accommodates multiple devices on a single line, as well as multiple phone numbers, each ringing a separate phone, or different numbers on the same phone. This helps respond to incoming calls differently based on the number dialed. SDS ISDN also permits up to three simultaneous "conversations" through the same twisted-pair line, and offers easy-to-use call-management features, such as hold, three-way conference calls, and call transfer from one phone to another.

ISDN installations can, of course, dial to and receive calls from ordinary voice telephones everywhere, since the digital and analog systems are interconnected.

For data, SDS ISDN offers two 56Kbps digital B channels – with inverse multiplexed speeds of up to 112Kbps without data compression – as well as one 16Kbps D channel. It is compatible with other Pacific Bell digital services, and offers dialed, fully digital data connections. Pacific Bell works with the major interexchange carriers – such as AT&T, MCI and Sprint – to establish the long distance ISDN channels needed for worldwide voice and data interconnection.

SDS ISDN is provided through a standard 1MB business line, and is available to virtually all Pacific Bell customers either through a digital switch in their area's central office, or through the *Alternate Serving Arrangement*, which links them to ISDN in a neighboring Pacific Bell location. One note: alternate serving arrangements may require a telephone number different from those in the local exchange.

Centrex ISDN

Centrex ISDN is Pacific Bell's BRI service available as part of Pacific Bell's Centrex service. It offers standard BRI 2B+D interfaces, and uses standard twisted-pair telephone lines for both voice and data communications.

With Centrex ISDN, Pacific Bell in effect allocates a segment of its central office switch to act as a dedicated PBX for the customer's ISDN system. The benefits are significant:

- First, these switches are state-of-the-art digital systems, staffed around the clock by highly trained engineers and technicians. They are also fully "disaster-prepared" and supplied with power backup in case of an emergency. Centrex services have traditionally offered superior performance, especially during earthquakes and power outages.
- Second, for smaller to mid-size businesses, Centrex ISDN offers the power and call-management features of a large modern switching system – at virtually the cost of the BRI connections themselves.

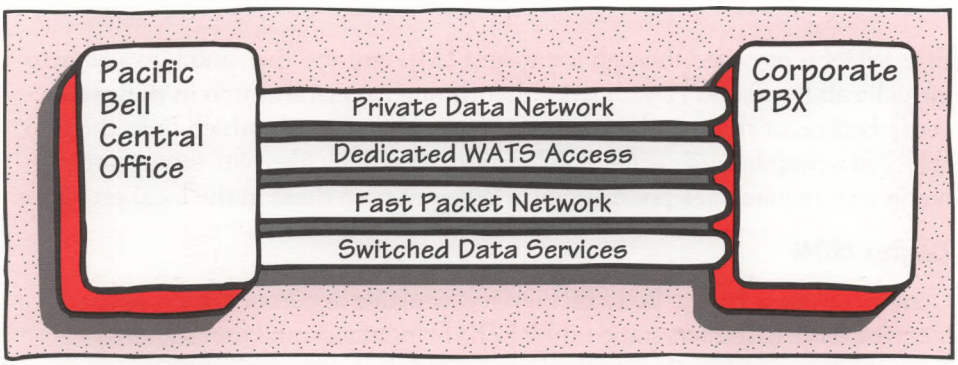
Primary Rate Interface Service

Pacific Bell's ISDN Primary Rate Interface (PRI) Service is provided through standard T-1 (1.544Mbps) point-to-point private-line facilities. The service enhances the capabilities of the basic T-1 digital trunk by dividing it into 24 digital 64Kbps channels (in effect, DS-0 trunks), and giving the user control of these individual channels.

At present – until the advent of *out-of-band* Signaling System 7 (SS7) in California, and its *interworking* to ISDN – each channel offers only 56Kbps of usable bandwidth for transmissions beyond the central office providing the PRI (because each B-channel must also carry an in-band 8Kbps D channel). B-channel transmissions within a single PBX or Pacific Bell switch can travel at the full 64Kbps bandwidth of the line.

Regardless of line speed, however, each B channel can be used for virtually any combination of data, voice, video or packet switching, and Pacific Bell's central office switch can dynamically change the configuration of channels in response to traffic needs, offering a range of advantages for standard operations.

For example, it gives PBX customers improved trunking capabilities by consolidating several services into a single T-1 trunk or group of trunks. Instead of having one group of connections for normal voice access, one for incoming 800-number lines, one for outgoing WATS services, and others dedicated to various data needs, it is now possible to allocate almost any channel to any function, wherever and whenever it's needed.



Pre-ISDN service selection. *Requires dedicated channels for each type of service.*

The Cost of ISDN in California

Line charges and one-time installation costs for ISDN in California. Prices subject to change.

	Centrex ISDN		SDS ISDN		Home ISDN	
	Monthly charge	*One-time charge*	*Monthly charge*	*One-time charge*	*Monthly charge*	*One-time charge*
Basic Service	$15.65	$70.00	$13.82	$70.75	$9.50	$34.75
ISDN	16.00	150.00*	11.00	125.00*	15.00	125.00*
D-channel Packet (optional)	4.00	25.00	4.00	25.00	4.00	25.00
Total	**$35.65**	**$245.00***	**$28.82**	**$220.75***	**$28.50**	**$184.75***

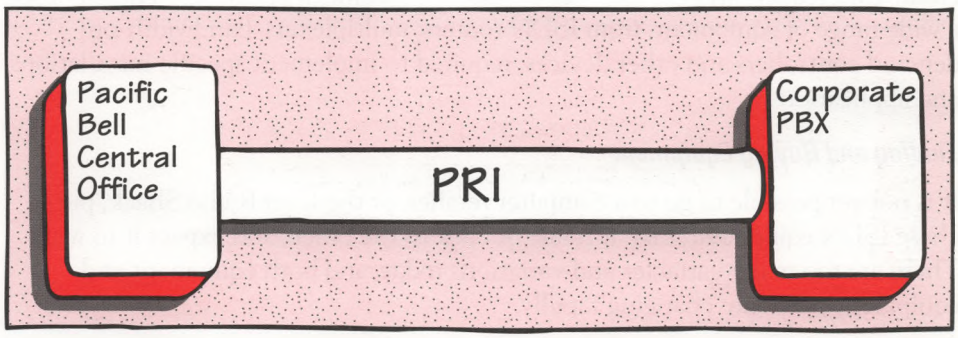
* One-time ISDN installation charges waived for a two-year commitment. Charges apply for early termination.

Groups of B channels (that is, 64Kbps DS-0 trunks) might be allocated during the day to exchange services, video conferences, and other voice or data needs. Later, after business hours, the same trunks can be combined for broadband data transmissions to and from remote computers. The result: more traffic through existing facilities, with much more productive use of each trunk.

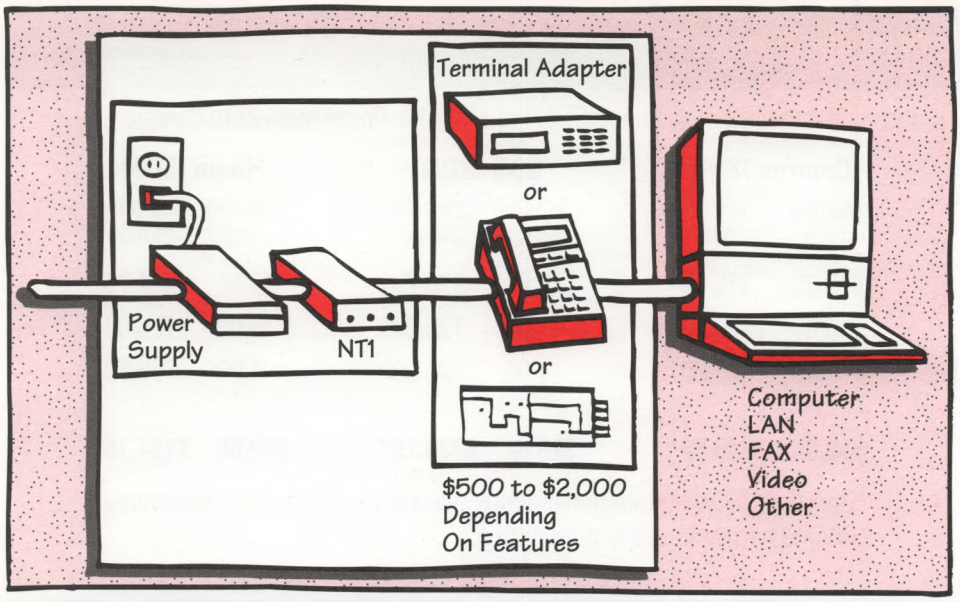
PBX customers can also consolidate their traffic to one or more interexchange carriers through a PRI connection to the central office, eliminating separate connections to each IEC. This also lets users take fuller advantage of discount plans for IEC services, and offers an alternative for customers who might otherwise have to maintain dedicated facilities to several of these carriers.

ISDN EQUIPMENT

In addition to an ISDN line from one of Pacific Bell's digitally equipped central offices, individual users will need to purchase or lease specific ISDN components, depending on the applications and uses envisioned.



ISDN call-by-call service. *Channels in a PRI can be allocated to services as needed.*



Some basic ISDN equipment needs. *Equipment can be leased or purchased from Pacific Bell and many other source.*

Some of these include:

✦ ***Network Termination Device.*** Called an NT1, this serves as a network interface for each BRI connection and offers two-to-four-wire conversion as well as line-testing capabilities. Current prices are about $150, although some manufacturers incorporate this device into other ISDN components.

✦ ***Power Supply.*** This device plugs into a standard wall outlet, and brings power to the ISDN line, which unlike an analog telephone line is not powered by Pacific Bell. Cost: less than $100, although some are integrated into the NT1.

✦ ***Terminal Adapter.*** The TA is a protocol converter that adapts equipment not specifically designed for ISDN to the digital world. Some devices, such as most ISDN telephones, have a built-in terminal adapter that can also be used to link PCs, fax machines and other non-ISDN devices. Prices range from $450-$1,500.

✦ ***Aggregation Device.*** This is a specialized terminal adapter that can aggregate, or combine, the two B channels "on the fly" into a single higher-speed connection. Some devices also include an Ethernet bridge. Prices begin at roughly $800.

✦ ***ISDN Telephones.*** Advanced, full-featured telephones incorporating a terminal adapter, and usually equipped with an advanced LCD screen for messaging and feature control. Prices start at about $450.

Also required, of course, is the equipment – PCs, workstations, or video systems, credit-card readers and the like – to be used for specific applications. There is also a wide range of equipment, from ISDN routers, multiplexers, bandwidth-on-demand controllers and other devices, required to implement specific installations and applications.

Finding and Buying Equipment

It is not yet possible to go to a computer retailer, or the local Radio Shack, purchase ISDN equipment, take it home or back to the office, and expect it to work. There are too many variables and variations today, and both equipment and equipment needs are changing rapidly.

As a result, and to make ISDN equipment more readily available, Pacific Bell has developed equipment joint-marketing arrangements with approved manufacturers and distributors. In this program, Pacific Bell tests each piece of equipment submitted to make sure that it works with the Pacific Bell ISDN services in the applications for which it was submitted. Then, through joint-marketing agreements, we offer much of this equipment to our customers at competitive retail prices.

The range of equipment tested and sold by Pacific Bell includes BRI links for a broad range of individual terminals, including Macintosh and MS-DOS personal computers, Sun and other Unix workstations, telecommuting equipment and PC video systems, LAN-to-LAN and LAN-to-host interface systems, other video and audio conference systems in a range of capabilities, remote-to-host and remote-to-LAN links for applications such as telecommuting, image transfer, multimedia, remote health diagnostics, electronic bulletin boards, point-of-sale systems and the like, Group 4 facsimile devices, and backup and overflow equipment for leased lines and networks. A partial list of equipment appears in Appendix A, and includes the name and contact points of the manufacturers – many of whom also offer information, assistance and support for ISDN installations.

Wiring Alternatives

While some homes and offices may need to be rewired for ISDN, most will not. The copper twisted pairs that currently serve analog telephones can be successfully used for the digital signals of ISDN. Nonetheless, depending on the usage of the ISDN line, and the number of existing handsets or other devices currently installed, those who plan on ordering ISDN may want to consider the costs and advantages of several wiring alternatives, as outlined in *Chapter 2* of this guide. The installation of a separate ISDN line can often be less expensive than the purchase of all new telephones, an integrated NT1/terminal adapter (called a *digital modem* by IBM), or other equipment.

GETTING STARTED NOW

For anyone in California interested in ISDN, or trying to gather more information on capabilities and applications, it makes sense to contact Pacific Bell directly for help on a range of issues, including:

- The feasibility and rough cost of the intended mix of applications.
- Recommendations on ways to enhance efficiency or cut costs.
- Possible equipment configurations, including expansion paths and costs.
- The availability of applications software and programming expertise.
- References to other users with similar applications whose experience may be useful, or guidance to specialized equipment and system integrators who can help plan and/or install a comprehensive applications response.

The ISDN Service Center

Pacific Bell, in fact, has taken steps to make the initial contact as productive and informative as possible by setting up an ISDN Service Center. Open in 1994, this facility is staffed by knowledgeable and technically expert communications consultants who can answer questions, offer advice, arrange for follow-up meetings or conferences as needed, and in general help customers get started with ISDN.

Help, support and information is available for any Pacific Bell customer, from small business owners looking for simple single-line BRI connections, to corporate MIS executives considering complex, multi-location systems. Pacific Bell consultants can also take orders for specific service and equipment installations on the spot, or identify and allocate specialized teams of sales and installation representatives. These ISDN experts are also knowledgeable in the full range of other Pacific Bell digital services, from the availability of dedicated links through the Advanced Digital Network, to the latest techniques for ultra-high-speed data transmission and networking.

The toll-free number of Pacific Bell's ISDN Service Center is 800-4PB-ISDN (800-472-4736). Assistance is also available through the Pacific Bell Telemarketing Center, 800-622-0735.

ISDN lines, equipment and applications expertise are also available from a range of other sources throughout California, including authorized value-added resellers (VARs) and authorized Pacific Bell sales agents.

Pacific Bell as a Partner

Whether you're interested in ISDN for new applications, or as an extension of existing facilities, Pacific Bell is ready to help with a growing level of support and service. From the smallest, single-line system to full nationwide or worldwide networks, the expertise of both Pacific Bell and your interexchange carrier is available to help you choose the right combination of lines and services, equipment and connections that can make ISDN a productive, cost-efficient tool.

The toll-free number of Pacific Bell's ISDN Service Center is 800-4PB-ISDN.

Pacific Bell resources can also help with the management and control of your system. For smaller users, detailed monthly invoices provide complete time, duration and cost information for every voice or data call, through both B and D channels. For larger customers, ISDN billing becomes an integral part of Pacific Bell's useful and comprehensive itemized statements, which include valuable management reports, and options for detailed breakouts of project, customer or departmental billing.

For most corporate ISDN orders, we also assign one or more ISDN specialists to work closely with your regular Pacific Bell account team. These specialists bring extensive knowledge of ISDN functions and requirements to every installation, as well as full understanding of equipment, cabling, power and other needs.

In short, Pacific Bell is committed to bringing the performance and value of ISDN to every area of California.To place an order, or simply to find out more about ISDN and its capabilities, contact your local Pacific Bell account team, or call the Pacific Bell ISDN Service Center, 800-4PB-ISDN.

ISDN is ready today. Pacific Bell believes that you are, too.

Appendix: ISDN Equipment & Suppliers A

Pacific Bell Executive Communications Centers

Located throughout California, Pacific Bell Executive Communications Centers offer both demonstrations and hands-on trials of many of the most popular applications of ISDN. These centers also demonstrate a range of selected equipment from many manufacturers, showing how this equipment responds to the specific needs of an actual application.

For information about attending either a general or an applications-oriented demonstration session, contact your Pacific Bell account representative, or call the nearest Executive Communications Center.

Anaheim, 200 W. Harbor Place, Suite 100, 800-533-3355
Los Angeles, 1010 Wilshire Boulevard, Suite 100, 800-322-0440
Sacramento, 2700 Watt Avenue, Room 2020, 800-322-0440
San Diego, 525 B Street, Suite 1700, 800-322-0440
San Francisco, 370 Third Street, Room 100, 800-533-3355
San Ramon, 2600 Camino Ramon, Room 1CN65, 800-533-3355
Santa Clara, 2900 Lakeside Drive, Room 201, 800-533-3355

Equipment Manufacturers

The manufacturers listed in the following pages offer ISDN equipment with specifications that respond to a broad range of ISDN applications. It is not a complete list, however. New products are continuously introduced, and equipment from companies not listed here may work equally well. This information has been compiled from a range of sources, including *Solutions '94*, the North American ISDN User's Forum catalog of ISDN applications and solutions.

Many but not all products from these manufacturers have been tested in the Pacific Bell Market Applications Lab to ascertain that they work satisfactorily with the applications listed. This list does not imply an endorsement of these products, although as part of our joint-marketing program, many can be leased or purchased through Pacific Bell.

Manufacturers' telephone numbers are local California numbers where possible, and are correct to the best of our knowledge. For more information, contact your Pacific Bell Account team, the Pacific Bell ISDN Service Center, 800-4PB-ISDN, or the Market Applications Lab, 510-823-1663.

Other non-ISDN equipment and software is also needed, of course, to implement the applications shown in the following pages. This includes PCs, workstations, computers and file servers, LANs and LAN-access hardware, video and/or sound equipment and the like. Manufacturers of these products are *not* listed here.

A full range of equipment and lines, as well as installation and applications assistance is also offered by many Pacific Bell-authorized sales agents, as well as Value-Added Resellers authorized by both Pacific Bell, manufacturers and others.

NT1s and Power Supplies

An NT1 and a power supply are required for every ISDN line. Although these devices are sometimes built into other ISDN products, especially telephones, the following vendors make standalone systems.

Adtran, 800-788-5408, 415-697-2848, 205-971-8000
AT&T Distributor: Volt, 800-566-8658
Siemens Stromberg-Carlson, 407-995-3037
Tone Commander Systems, 800-524-0024

Terminal Adapters

ISDN applications require a terminal adapter, although this function may also be built in to other equipment. The companies below make terminal adapters that support both voice and data calls for modem replacement, remote access to a LAN, telecommuting, BBS access, groupware, large file transfers, etc. Some units include an integrated ISDN phone, others include a jack to plug an ordinary analog telephone (or fax, or modem, or answering machine) into them.

Adtran, 800-788-5408, 415-697-2848, 205-971-8000
AT&T Distributor: Volt, 800-566-8658
Controlware Communications Systems, Inc., 908-919-0400
Fujitsu ISDN Division, 800-228-ISDN (4736)
Gandalf Systems Corp., 609-424-9400
Hayes Microcomputer Prods., Inc., 415-974-5544, 404-441-1617
Integral Communications, Inc., 800-ICI-8234
ISCOM, Inc., 301-779-1368
Motorola UDS, 510-734-8820, 714-285-0824, 205-430-8902
Newbridge Networks Inc., 201-818-2766
Northern Telecom Inc., 800-992-2303, 919-255-8946
Racal-Datacom, Inc., 305-846-6762
TelePower, 818-587-5540
XAN Communications, Inc., 315-787-8183

Personal Computer Cards

These cards most often install in the personal computer or workstation and adapt it for communications with the ISDN network.

AT&T Distributor: Volt, 800-566-8658
Connective Strategies, Inc., 703-802-0023
CoSystems, Inc., 408-748-2190
DGM&S, Inc., 609-866-1212

Digiboard, 800-344-4273
Eicon Technology Corp., 514-631-2592
EuRoNis, +33-142334098, Paris
Extension Technology Corp., 415-390-8130, 508-872-7748
Fujitsu ISDN Division, 800-228-ISDN (4736)
Hayes Microcomputer Prods., Inc., 415-974-5544, 404-441-1617
Hewlett-Packard, 800-637-7740
International Business Machines Corp., 800-IBM-CALL, 919-254-0434, 507-253-7294
ISCOM, Inc., 301-779-1368
ISDN Systems Corp., 703-883-0933
Link Technology, Inc. 215-357-3354
Mitel Corp., 613-592-2122
Motorola UDS, 510-734-8820, 714-285-0824, 205-430-8902
MPR Teltech Ltd., 604-293-6047
NCR Network Products Division 612-638-7685, 612-638-7828
OST, Inc., 403-817-0400
Silicon Graphics, 415-390-2522
Sun Microsystems Computer Corp., 415-336-4433

ISDN Telephones

These phones link directly to ISDN. Many have the required NT1 and power supply built it, and some even incorporate jacks to accommodate faxes, answering machines and other devices.

AT&T Distributor: Volt, 800-566-8658
Cartelco, Inc. 901-365-7774
Fujitsu ISDN Division, 800-228-ISDN (4736)
Lodestar Technology, Inc., 800-378-6316
Motorola UDS, 510-734-8820, 714-285-0824, 205-430-8902
Northern Telecom Inc., 800-992-2303, 919-255-8946
Siemens Stromberg-Carlson, 407-955-3037
Telrad Communications, 516-921-8300

ISDN LAN Bridges

Products from these manufacturers let PCs connect from a remote location to a LAN or host computer, but do not include a voice capability. Most of the voice/data terminal adapters listed above will also provide dial-up access to a LAN or host.

AT&T Distributor: Volt, 800-566-8658
Combinet, Inc. 408-522-9020
Develcon Electronics Limited, 306-933-3300
Digiboard, 800-344-4273
Gandalf Systems Corp., 609-424-9400
ISCOM, Inc., 301-779-1368

Communications Servers, Routers, Bridges

LAN-to-LAN connectivity equipment to link one LAN to another, with dialed connections over ISDN made on demand.

Advanced Computer Communications, 408-864-0600
Ascend Communications, Inc., 510-769-6001
AT&T Distributor: Volt, 800-566-8658
Cisco Systems, Inc., 415-326-1981
Connective Strategies, Inc., 703-802-0023
Digiboard, 800-344-4273
Engage Communications, Inc., 408-688-1021
Gandalf Systems Corp., 609-424-9400
Hewlett-Packard, 800-637-7740
International Business Machines Corp., 800-IBM-CALL, 919-254-0434, 507-253-7294
International Transware, Inc. 800-999-6387
ISDN Systems Corp., 703-883-0933
MPR Teltech Ltd., 604-293-6047
NCR Network Products Division 612-638-7685, 612-638-7828
NEC (Dr. Bond), 800-222-4NEC
OST, Inc., 403-817-0400
Racal-Datacom, Inc., 305-846-6762

Inverse Multiplexers, Multiplexers and Communications Servers

Equipment to connect one LAN to another, with dialed connections over ISDN on demand. Also automatic back-up equipment which dials one or more ISDN lines to handle emergency outages or data overflow on a private-line network.

Ascend Communications, Inc., 510-769-6001
AT&T Distributor: Volt, 800-566-8658
Controlware Communications Systems, Inc., 908-919-0400
Newbridge Networks Inc., 201-818-2766
Primary Rate Inc., 800-950-ISDN
Promptus Communications, Inc., 401-683-6100
TyLink Corp., 508-285-0033

Video Conferencing and Videophones

The following companies make videoconferencing codecs, room and desktop video sets, as well as other specialized equipment for video transmission.

AT&T Distributor: Volt, 800-566-8658
BT Visual Images, 800-778-6288
Compression Labs, Inc., 408-428-6759
Hitachi America, 404-242-1410
Intel Corporation, 800-538-3373-
ISCOM, Inc., 301-779-1368
Northern Telecom Inc., 800-992-2303, 919-255-8946
PictureTel, 800-742-8351
Vitel, 800-856-8835

Appendix: Information & Other Resources

B

PACIFIC BELL

Pacific Bell ISDN Service Center

The specialized *ISDN Service Center* is staffed with knowledgeable experts in both digital transmission in general and ISDN in particular. They can offer help with applications, equipment, line access and availability, applications and program availability, and many other aspects of installing and using ISDN.

The *ISDN Service Center* can also take orders for ISDN lines and equipment right over the telephone, and can help coordinate the activities of your Pacific Bell account team with ISDN and other specialists. The number of the ISDN Service Center is 800-4PB-ISDN. You can also call 800-622-0735, the Pacific Bell *Marketing Hotline*, for help or general information on ISDN or other Pacific Bell services.

Pacific Bell Market Applications Lab

The lab has tested a broad range of ISDN equipment, and can help answer questions about the suitability of ISDN for your application and the types of equipment you should consider. The number is 510-823-1663.

Pacific Bell Sales Agents and VARs

Authorized Pacific Bell sales agents, as well as value-added resellers (VARs) from a range of companies also represent a major source of information and assistance. Many of these, such as VARs for Intel Proshare desktop video systems, are knowledgeable specialists in specific applications and uses of ISDN equipment.

Pacific Bell Applications Bulletin Board Service

A database of Pacific Bell's products and applications is available for public dial-in access. The focus is on business products, including ISDN. Terminal emulation: VT100, ANSI BBS or TTY. Communications settings are: N, 8, 1. The numbers:

- By modem (up to 14.4Kbps): 510-277-1037
- By ISDN (up to 57.6Kbps): 510-823-4888

Pacific Bell on the Internet

For those with access to the *Internet*, information is available through the Pacific Bell *Gopher* server. It is also possible to reach specific groups or individuals through e-mail. The Internet address for information on ISDN, for example, is: ISDN.info@pacbell.com.

Pacific Bell Faxback Service

A broad range of general documents, product and application information can be obtained by fax. Call 800-995-0346, and follow the prompts. It is often easiest to first order the general list of all documents, and use that to order more information.

Pacific Bell Executive Communications Centers

These centers, located throughout California, offer demonstrations and information about ISDN and a range of other telecommunications applications. See the listing of these centers in the previous appendix.

COMMUNICATIONS INDUSTRY

Bellcore ISDN Deployment Data

Issued periodically, this report contains detailed information on ISDN equipment and deployment throughout the seven Regional Bell Operating Companies (RBOCs). This and other information is available by contacting: Bellcore, Customer Service, 8 Corporate Place, Rm. 3C-183, Piscataway, NJ 08854-4156.

USER GROUPS

California ISDN Users Group (CIUG)

The CIUG is a valuable source of information about ISDN. They maintain a significant library of information, and are in the process of developing application examples and other materials helpful in understanding and using ISDN, especially in California. Contact: Stan Kluz, P.O. Box 808, L-550, Livermore, CA 94550. Telephone: 510-423-7757. Fax: 510-423-0186. E-mail: Kluz1@llnl.gov.

North American ISDN Users Forum (NIUF)

The National ISDN Users Forum maintains a large catalog of ISDN applications actually implemented by organizations nationwide. Updated periodically, it contains detailed equipment requirements and contact numbers. For information, the NIUF can be reached at: NIUF Secretariat, c/o NIST, Bldg. 223, Rm. B364, Gaithersburg, MD 28099. Telephone: 301-975-2937; fax: 301-926-9675. The catalog file can also be downloaded through the *Internet* at info.bellcore.com (*the file is in EPS format*).

The NIUF has also issued a brief but detailed publication on *ISDN Wiring and Powering Guidelines for the Residence and Small Business*. To order, contact the NIUF Secretariat at the address and phone number above.

Pacific Region ISDN/DATA User Forum (PRIDUF)

The Pacific Region ISDN/DATA User Forum is an important group formed under the Pacific Telecommunications Council. It is open to existing and potential users of advanced digital services in the Pacific Region. The forum gives users, network operators and vendors an opportunity to work together on various applications and services within the region. For more information, contact: Dick Barber, Executive Director, PTC, 2454 S. Beretania St., Suite 302, Honolulu, HI 96826. Telephone: 808-941-3789. Fax: 808-944-4874. E-mail: 4174965@mcimail.com.

BOOKS

ISDN: A User's Guide, France Telecom, 1992
An excellent general guide, with added emphasis on overseas usage and worldwide ISDN interconnection. France Telecom, Inc., 1270 Avenue of the Americas, New York, NY 10020. Telephone: 212-322-2149.

The Basics Book of ISDN, 2nd Edition, Motorola University Press, 1993
An introduction to ISDN, with emphasis on technical implementation for MIS and data communications professionals. $10.95. Motorola, 20 Cabot Blvd., Mansfield, MA 02048. Telephone 508-261-4000. Fax: 508-337-8004. Also available through many business, technical and computer bookstores.

Illustrated ISDN, Bo Lindgren & Leif Jonsson, 2nd Edition, Infotrans
Subtitled "a painless primer to principles and protocols," it offers a good general introduction to the technical elements of ISDN. In English, $49.95. Infotrans, PO Box 939, S-391 29 Kalmar, Sweden. Fax +46 480 51512. Once backordered nationwide, it is now available again through bookstores in the United States.

Sensible ISDN Data Applications, Jeffrey Neil Fritz, West Virginia University Press
This well-written, often humorous book chronicles how ISDN answered an array of connectivity needs at West Virginia University, and helped the school move toward a coordinated campus network. This book will be useful to anyone interested in organizational connectivity in any field. West Virginia University Press, PO Box 6069, Morgantown, WV 26506-6069. Telephone: 304-293-5267. The price is $29.95.

The ISDN Literacy Book, Gerald Hopkins
Available in December 1994, this unique survey places ISDN in its social, cultural and economic context. Covers the motivation for ISDN, its applications and technology. Published by Addison-Wesley. Telephone number: 800-447-2226. ISBN number: 0-201-62978-8. Price is $34.50.

ISDN Solutions
An intelligent layman's introduction to ISDN and its applications. Published by the Corporation for Open Systems International, 8260 Willow Oaks Corporate Drive, Fairfax, VA 22031. Telephone: 703-205-2700.

AT&T Publications
AT&T offers more than 25 publications on ISDN and related customer premises equipment. For more information, call the company's customer information center at 800-432-6600.

3Com Publications
Two current publications on ISDN are available from 3Com: *ISDN and Dial-Up Connectivity: Switched Data Solutions for Remote and Personal Office Interworking*, and a white paper *Teleworking*. Both are available from local 3Com sales offices.

INFORMATION ON THE INTERNET

A growing range of information is available through the Internet.

- Bellcore makes several public-domain ISDN documents available. Most significant of the current publications is *A Catalog of National ISDN Solutions for Selected NIUF Applications*. To access a range of Bellcore information using *Mosaic*, use the URL "http://www.bellcore.com/ISDN/ISDN.html."
- The Internet *Usenet* service includes a newsgroup called comp.dcom.isdn – devoted to discussion of ISDN-related topics. You can post questions to the newsgroup and get responses from around the world; you can answer other's questions; or you can "lurk" – reading questions and answers while remaining anonymous.
- This publication, with graphics, is available through the Internet. With *Mosaic*, use the URL "http://www.pacbell.com." This places you on the Pacific Bell home page. From there, select the *ISDN User's Guide*.

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